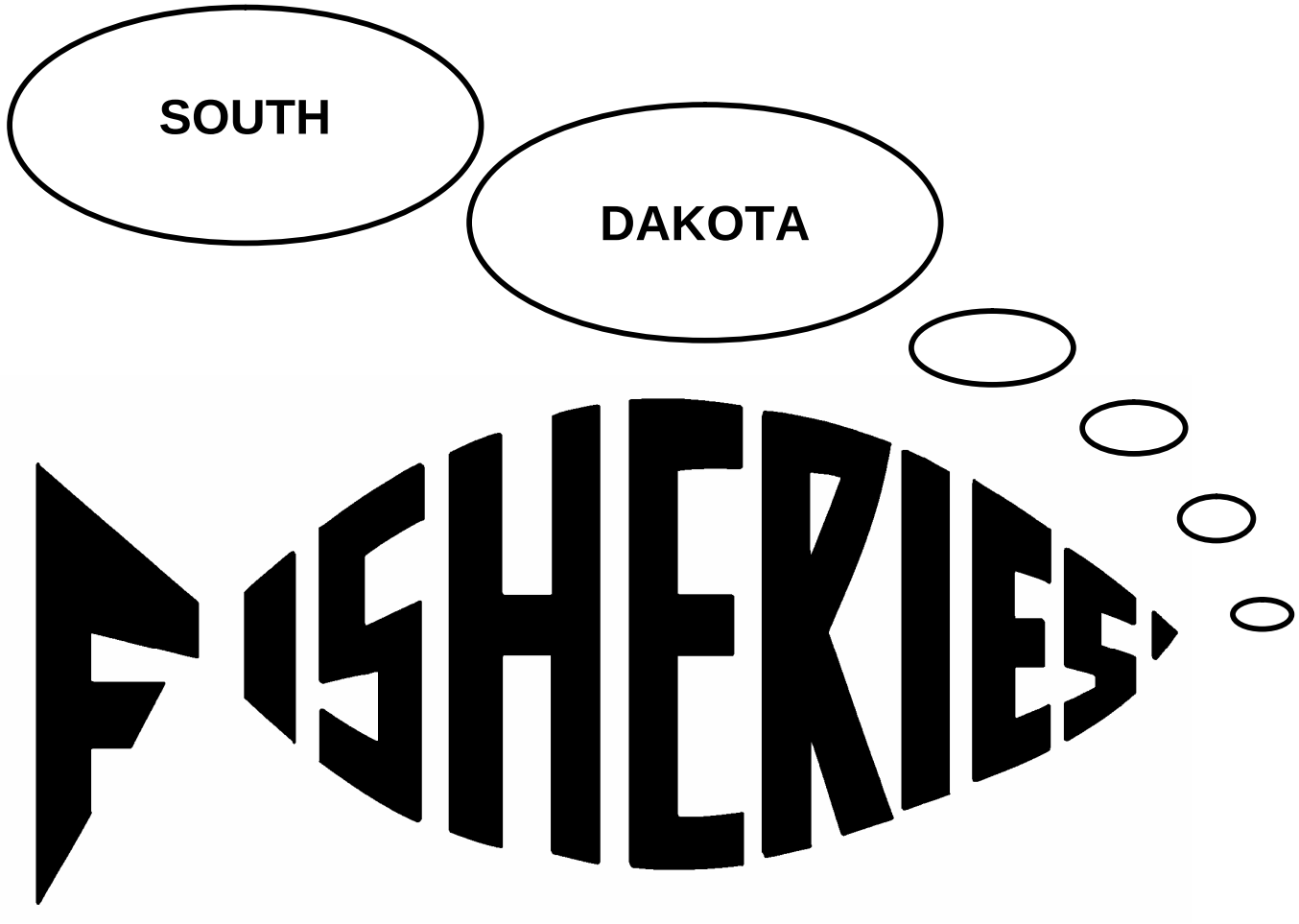

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE SHARPE, SOUTH DAKOTA, 2003

South Dakota Department of Game, Fish and Parks
Wildlife Division
Joe Foss Building
Pierre, South Dakota 57501-3182

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ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE SHARPE, SOUTH DAKOTA, 2003

by

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PREFACE

Information collected during 2003 is summarized in this report. Copies of this report and references to the data can be made with permission from the authors or Director of the Division of Wildlife, South Dakota Department of Game, Fish, and Parks, 523 E. Capitol, Pierre, South Dakota 57501-3182.

The authors would like to acknowledge the following individuals from the South Dakota Department of Game, Fish, and Parks who helped with data collection and analysis, manuscript preparation, and report editing; Brian Beel, John Kallemeyn, Darla Kusser, Kelly Ness, Joe Riis, Jim Riis, Sylvester Schied, Robert Schunot, Robert Stoeser, Nathan Wagner, Jeanie White, and Jason Sorensen.

The collection of data for these surveys was funded, in part, by Federal Aid in Sport Fish Restoration, (D-J) project F-21-R-36, Statewide Fish Management Surveys. Some of these data have been presented previously in segments F-21-23 through 33, and South Dakota Department of Game, Fish and Parks, Wildlife Division, Report No. 96-7.

EXECUTIVE SUMMARY

This report includes annual fish population data from 1999 through 2003 and angler use, harvest and preference data for 2003, for Lake Sharpe, South Dakota. Angler use and harvest survey data from previous years is also referenced in this report. Results of these surveys are used to evaluate progress towards strategic plan objectives as outlined in the Missouri River Fisheries Program Strategic Plan. Data interpretation and discussion relate to changes in fish community and population structure, angler use, harvest, and preference, and evaluation of management activities and regulations.

Seventeen fish species were collected with gill nets in the 2003 Lake Sharpe fish population survey. Mean catch per unit effort (CPUE) values, for all species, for 2003, were not significantly different from 2002 values. Walleye and channel catfish mean CPUE in the 2003 gill net survey were similar at 19.6 and 18.7 fish/net-night, respectively, and higher than all other species sampled. Eight species of age-0 fishes and six species of small prey fishes were collected during the 2003 standard seining survey in early August. Gizzard shad mean CPUE in seine haul catches decreased from 1,459.7 fish/haul in 2002 to 244.4 fish/haul in 2003; the fourth lowest since initiation of the seining survey in 1982.

Walleye population age structure, as determined from aging otoliths, revealed that the 2000 year class comprised 33% of the 2003 gill net sample, while the 1998, 1999 and 2001 year classes comprised 8%, 19%, and 23%, of the total sample, respectively. Walleye relative weight (*Wr)* values in Lake Sharpe in 2003 were lower than other years in the 1997-2003 period, possibly due to low production of age-0 gizzard shad in 2003. Mean Wr values of 72 for quality-preferred- and 66 for preferred-length walleyes may be indicative of slow growth during 2003 and a lack of replacement of fish harvested in 2003 for the 2004 fishing season. The annual survival rate estimate from catch-curve analysis, for pooled 2002-2003 otolith data, was 63%, substantially higher than the 49% survival estimated from scale data. Walleye population proportional stock density in the 2003 gill net survey, at 34, was within the balanced range of 30-60 but also the lowest value of the 1997-2003 period.

Estimated fishing pressure for the April-September 2003 daytime period on Lake Sharpe was 397,220 h, similar to the 2002 estimate of 385,357 h and within the range of estimates generated for other surveys. An estimated 111,938 walleyes were harvested by anglers during the April-September 2003 daytime survey period and an estimated 433,788 walleyes were released. The percentage of angling parties harvesting a four-fish limit of walleye decreased in 2003 from previous years and was the lowest of the 1997-2003 period, at 9%. Estimated hourly catch and release rates for all species combined for the April-September 2003 daytime period, at 2.02 fish/h and 1.62 fish/h, respectively were higher than values for the same period in 2002. Anglers specifically fishing for walleyes had a mean hourly catch rate of 2.25 fish/h for the April-September daytime period. During 2003, mean catch per trip peaked in June at 7.7 walleye/trip but mean harvest per trip in June, at 0.4 walleye/trip, was the lowest of the April-September period.

Approximately 79% of the angler trips on Lake Sharpe during the April-September 2003 daytime period were made by South Dakota residents. When anglers were asked to consider all factors when stating their level of satisfaction with their fishing trip, the median trip rating for the April-September period was “slightly satisfied”, a decrease from the 2002 median value “moderately satisfied”. Sixty percent of angling parties indicated

some degree of satisfaction, a value below the Lake Sharpe Strategic Plan objective of 70%.

Total trout fishing effort in Oahe Marina from February through May 2003 was 4,651 hours with an average trip length of 1.79 hours. Hourly catch rates of rainbow trout by anglers ranged from a low of 0.31 trout/h in March, for fly anglers, to a high of 5.22 trout/h in April for bait/spincasting anglers. Harvest rates of carryover trout ranged from a high of 0.62 trout/h in March for ice anglers (March 1st through 15th) to a low of 0 trout/h for fly anglers in April. Total harvest of carryover rainbow trout was estimated at 1,226 fish, for the February-May 2003 period. An estimated 17,458 rainbow trout were caught by anglers from February through May 2003. An estimated 9% (3,077) of the catchable trout stocked were harvested by anglers during April and May 2003. Seventy percent of anglers fishing the Oahe Marina for trout during the February-May 2003 period rated their trip “good” or “excellent”.

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ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE SHARPE, SOUTH DAKOTA, 2003

INTRODUCTION

Anglers spent over 2.0 million hours fishing the Missouri River system in South Dakota in 2002 (Lott et. al 2003a; Lott et al. 2003b; Stone and Sorensen 2003). In a 1993 angler use and preference survey (Mendelsohn 1994), 50% of resident respondents listed Missouri River reservoirs as their preferred fishing area. The South Dakota Department of Game, Fish and Parks (SDGFP) recognizes the importance of the Missouri River fisheries program and considers it a major program in current strategic planning efforts (SDGFP 1994).

Lake Sharpe is a 128-km long mainstem Missouri River flow-through reservoir and has a surface area of 24,686 ha. Lake Sharpe has supported between 60,000 and 100,000 angler trips, during the April-September daylight period, in recent years (Stone et al. 1994, Johnson et al. 1998; Johnson and Lott 1999; 2000; 2001; Johnson et al. 2002; Lott et al. 2003b). Walleye, and to a lesser extent, smallmouth bass, white bass, channel catfish, sauger, and rainbow trout, provide most of the sport fishing opportunity in this reservoir. Current fish population parameters and sport fisheries are good, based on fish abundance and angler catch rates.

Lake Sharpe is an important fisheries resource in South Dakota and its habitat and fish community must be protected and maintained. The importance of Lake Sharpe to Missouri River fisheries is documented in the goal, objectives and strategies developed for management of this system (SDGFP 1994). Conducting annual surveys documenting fish community and population parameters, in association with collecting data on angler use, harvest, attitudes, preferences, and level of satisfaction, are primary strategies outlined in that plan. This information is required for evaluation of objectives and strategies and to identify future management strategies. Trends and status of fish populations discussed in this report provide valuable information for evaluation of walleye regulations implemented in 1999. This report includes data collected for Lake Sharpe in 2003 and comparisons to data from previous years.

OBJECTIVES

The objectives of the surveys discussed in this report are to provide information on or estimates of:

Annual fish population surveys (Federal Aid Code 2102):

1. species composition
2. relative abundance
3. population age structure
4. growth
5. condition
6. recruitment
7. survival and mortality rates
8. population size structure
9. effects of regulations
10. effects of sport fish harvest

Angler use, harvest, and preference surveys (Federal Aid Code 2109):

1. recreational angling pressure
2. fish harvest, release and catch rates, by species
3. angler party size, day length, and state of residency
4. annual local economic impact of the sport fishery
5. effects of regulations and other management activities
6. size structure of fish in the harvest
7. angler preference, attitude and satisfaction information

STUDY AREA

Lake Sharpe is located in central South Dakota (Figure 1) and extends from Oahe Dam to Big Bend Dam. The reservoir has been divided into three zones for survey purposes. The upper zone extends from Oahe Dam to the downstream end of LaFramboise Island, the middle zone extends from the downstream end of LaFramboise Island to DeGrey, and the lower zone extends from DeGrey to Big Bend Dam. Standard gill netting, seining and electrofishing locations have historically been Farm Island, DeGrey, Joe Creek and North Shore. However, beginning in 2003, Fort George was sampled instead of DeGrey, during the standard seining, gillnetting, and fall electrofishing surveys, due to access issues related to siltation in the DeGrey area. Electrofishing is also conducted at LaFramboise Island and the Oahe Dam stilling basin. Historical, biological, chemical and physical parameters have been discussed previously (Benson 1968; Riis 1986; Schmidt 1975). Table 1 presents selected physical characteristics, management classification and fish population survey schedules for Lake Sharpe.

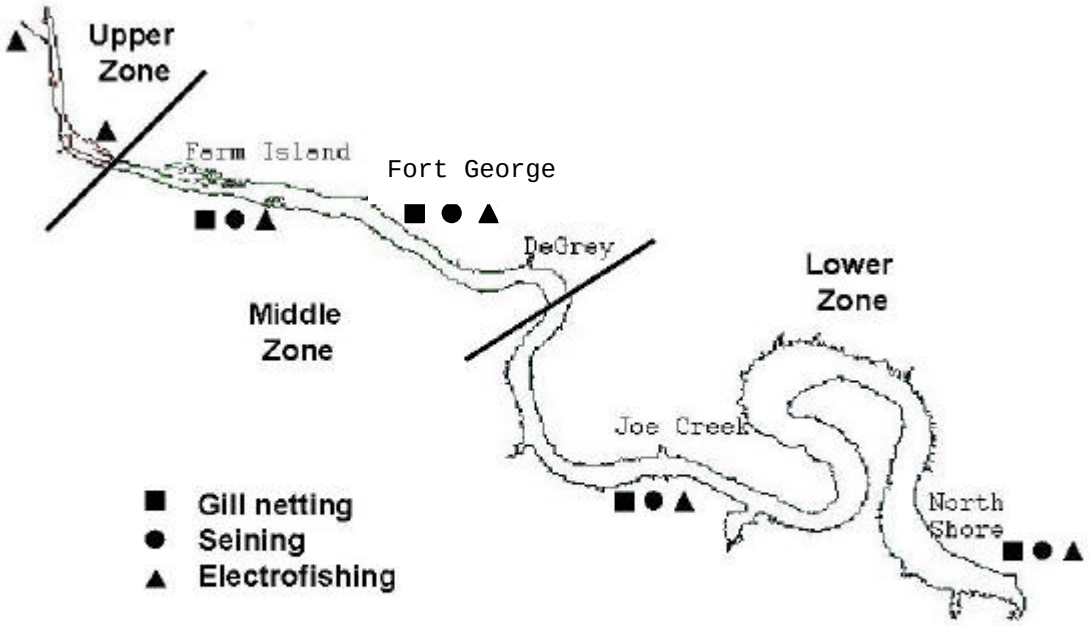

Figure 1. Lake Sharpe, South Dakota, gill netting, seining and electrofishing locations.

Table 1. Physical characteristics at normal pool elevation, management classification, and sampling times and depths, for annual fish population surveys on Lake Sharpe, South Dakota.

Characteristic:	Description
Location:	From Oahe Dam to Big Bend Dam
Surface area (X 1000 ha):	25
Depth (m)-maximum:	23.5
-mean:	9.5
Bottom substrate:	Sand, gravel, shale and silt
Water source:	Missouri River and tributaries
Management classification:	Cool and warm water permanent
Gill net depths: (m)	0 - 9.1 9.1 - 18.3
Number of gill nets:	24
Gill netting survey date:	August
Number of seine hauls:	16
Seining survey date:	August
Nighttime electrofishing	May-June, September-October

SAMPLING METHODS

FISH POPULATION SURVEYS

Data Collection

Variable-mesh gill nets, seines and boat electrofishing were used to sample fish populations in Lake Sharpe during 2003 (Figure 1). Three standard gill nets (Lott et al. 1994) were fished overnight, on the bottom, in each depth zone (0-9.1 m and >9.1 m), where possible, at each location (Table 1, Figure 1). All fish collected were identified and counted. Stock-length fish (Anderson and Weithman 1978) of all species sampled were measured for total length (TL; mm) and weighed (g). Scale samples and otoliths (10 per cm length group per sampling location) were collected from walleye and sauger. Scales were removed from a location below the lateral line and at the tip of the pectoral fin (Al-Absy and Carlander 1988). Otoliths were removed from all walleye sampled in gill nets. Otoliths were broken in half and charred prior to aging. Channel catfish pectoral spines were removed and aged according to techniques described in Sneed (1951). Spines were sectioned near the distal end of the basal groove using a low-speed isomet saw.

Nylon seines, previously described by Lott et al. (1994), were used to collect age-0 fishes and small littoral species. A quarter-arc seine haul was accomplished by methods described in Martin et al. (1981). Four seine hauls were made at each sampling location. All fish collected with seines were identified and counted.

Spring (May and early June), nighttime electrofishing was used to gather data on smallmouth bass population parameters. Smallmouth bass captured were measured (TL; mm), weighed (g) and scales were taken from 10 smallmouth bass per centimeter length group, at each sampling location.

Fall (Sept./Oct.), nighttime electrofishing for age-0 walleye was included in standard fish population surveys beginning in 1995 to assess walleye reproduction. Beginning in 1998, a sampling location was included at DeGrey to provide uniformity between electrofishing, seining, and gill-netting survey sites. In 2000, electrofishing sites at LaFramboise Island and the Oahe Dam stilling basin were added to the list of standard electrofishing sites. In 2003, DeGrey was replaced with Fort George, as a standard seining, gill netting, and electrofishing station, due to a lack of access at Degrey, from siltation. Six, 15-minute electrofishing runs were conducted at night, during September, along the shoreline, at each sampling location. A 5.3-m Smith-Root SR-18 electrofishing boat, with a 5.0 GPP electrofisher, was used to conduct the survey. The electrofishing unit was set for pulsed D.C. current and a 30 pulse/sec frequency. Voltage and amperage ranged between 270-300 V and 7-10 A, respectively. Scales were taken from a representative sample of walleye <200-mm in length to determine the maximum length for age-0 fish.

A list of common names, scientific names, and species abbreviations for fish mentioned throughout this report is presented in Appendix 1.

Data Analysis

Relative abundance of fish species were expressed as mean catch per unit effort (CPUE) for standard gill net (No./net night), seine (No./haul) and electrofishing (No./h) catches. A standard net night for the gill-net survey was approximately 20 h. Age and growth analyses were conducted for walleye, sauger, channel catfish, and smallmouth bass. Scales and otoliths were aged according to standard techniques (DeVries and Frie 1996) and pectoral spines were aged according to techniques outlined in Sneed (1951). Back-calculations for scale and pectoral spine samples were made with the computer program WinFin Analysis (Francis 2000). Standard y-intercept values for growth analyses of 55 mm, for walleye and sauger, 35 mm for smallmouth bass (Carlander 1982), and 30 mm for channel catfish (Nebraska Game and Parks, unpublished) were used. Age distributions for gill-net catches of walleye and sauger were developed by assigning ages to all fish captured during the survey, based on length-at-age-at-time-of-capture information. Proportional stock density (PSD; Anderson 1980) and relative stock density (RSD; Gablehouse 1984) values were calculated for walleye, sauger, channel catfish, white bass, and yellow perch. Length categories used in PSD and RSD calculations for walleye, sauger, channel catfish, white bass and yellow perch are listed in Table 2.

Relative weight values (*Wr;* Anderson 1980) were calculated using standard weight (W_s) equations developed for smallmouth bass (Kolander et al. 1993), walleye (Murphy et al. 1990), sauger (Guy et al. 1990), channel catfish (Brown et al. 1995), white bass (Brown and Murphy 1991) and yellow perch (Willis et al. 1991). Standard weight equations used in this report are provided in Appendix 2. Stock density indices (PSD, RSD) and mean *Wr* values for white bass and yellow perch are presented in Appendix 3.

Table 2. Minimum lengths (mm) for length class designations for smallmouth bass, walleye, sauger, channel catfish, white bass and yellow perch.

Species	Stock	Quality	Preferred	Memorable	Trophy
Smallmouth Bass	180	280	350	430	510
Walleye	250	380	510	630	760
Sauger	200	300	380	510	630
Channel catfish	280	410	610	710	910
White bass	150	230	300	380	460
Yellow perch	130	200	250	300	380

Walleye *Wr* values for fish in gill net samples were tested for differences among years, within stock density index groupings, using a one-way ANOVA (SYSTAT 1998). Length and CPUE of age-0 walleye in fall electrofishing samples were tested for differences among years using a one-way analysis of variance (ANOVA). Standard error values were generated for gill net and seine haul mean CPUE values as a measure of sample variance. An alpha level of 0.05 was established, a priori, for all statistical tests.

Survival and mortality estimates for walleye and channel catfish were calculated using catch curves (Ricker 1975). To reduce the effects of variable recruitment, two consecutive years of age-distribution data were combined for analyses. To estimate instantaneous mortality rates (Z), the slope of the regression of the natural logarithm of the number of fish of each age on fish age was used. Simple linear correlation analyses were done between indices of walleye recruitment (age-0 seining, age-0 gill net, age-0 electrofishing and age-1 gill net CPUE). Multiple regression analyses comparing indices of walleye recruitment included the addition of mean length of age-0 walleye in the fall nighttime electrofishing survey as a dependent variable.

ANGLER USE AND SPORT FISH HARVEST SURVEYS

Reservoir-Wide Angler Use and Harvest Survey

Prior to 2003, angler use and sport-fish harvest survey techniques were patterned after a study designed and conducted on Lake Sharpe, South Dakota, by Schmidt (1975). This survey consisted of two independent parts. First, aerial pressure counts were used to estimate fishing pressure. Second, angler interviews were used to obtain estimates of individual angler harvest and catch and release rates. In an effort to increase the statistical reliability of the pressure estimate, a bus route survey design (Jones and Robson 1991) was employed in 2003. A bus route design is a modified access survey typically used for fisheries with numerous access sites spread over a broad geographical region (Robson and Jones 1989; Jones et al. 1990) For a more detailed description of the bus route theory and techniques see Robson and Jones (1989), Jones and Robson (1991), and Pollock et al. (1994).

Sampling was conducted from April 1, 2003 through September 30, 2003 for the sunrise-to-sunset (daytime) period. The upper and middle zones of Lake

Sharpe were also surveyed during October 2003. Pressure count and angler interview data were entered and analyzed using the Creel Application Software (CAS) package (Soupir and Brown 2002) and 95% confidence intervals were calculated for estimates of fishing pressure and harvest.

ANGLER SATISFACTION, PREFERENCE, AND ATTITUDE SURVEY

Angler preference questions were included in each angler interview during the 2003 reservoir-wide angler use and harvest survey. Two different versions (forms A and B) of the angler interview data sheet were created, with different sets of angler attitude or preference questions on each sheet. Clerks alternated between forms A and B during each scheduled survey day. Anglers were asked to rate their fishing trip based on the numbers and sizes of fish they were expecting to catch and to state how satisfied they were with their fishing trip, considering all factors. Other questions asked were related to the number of days anglers fished, what a reasonable number of walleyes was to harvest in a year and how many walleyes anglers' harvested during a typical year. A list of attitude and preference questions used during the 2003 survey appears in Appendix 4. Median values for trip rating and satisfaction question responses were calculated for each month and for the entire sample.

OAHE MARINA ANGLER USE AND HARVEST SURVEY

Rainbow trout have been stocked annually in the Oahe Dam tailwaters since 1981. Fingerling cutthroat trout were stocked from 1984 to 1986 and catchable size brown trout have not been stocked since 1999.

In 2003, a roving creel survey was conducted at the Oahe Marina, a less than 1 ha backwater area, connected to the Oahe Dam tailwaters of Lake Sharpe. The creel survey was modeled after one described by Malvestuto and Davies (1978). A roving creel was used to maximize the number of interviews with a minimal amount of effort during variable weather conditions from February to May. Information collected from this creel was used to estimate angler use and harvest of carryover trout and newly stocked catchable rainbow trout by angler group. Angling groups were separated by gear type into three categories: ice fishing anglers, bait/shore anglers and fly fishing anglers.

There were two objectives of this creel survey. First, determine the catch, harvest and release rates of carryover and newly stocked catchable trout in the Oahe Marina. Second, determine if increased stocking of catchable trout in Oahe Marina could compensate for the loss of interbasin transfer of trout from Lake Oahe to the Oahe Marina fishery.

RESULTS AND DISCUSSION

FISH POPULATION SURVEYS

Species Composition and Relative Abundance

Seventeen fish species were collected with gill nets in the 2003 Lake Sharpe fish population survey (Table 3). All fish species collected during 2003 had been previously sampled in Lake Sharpe (Michaletz et al. 1986; Riis et al. 1988; Stone et al. 1989; Johnson et al. 1990; Wickstrom et al. 1991; Johnson et al. 1992; Wickstrom et al. 1993; Lott et al. 1994; Riis and Johnson 1995; Riis et al. 1996; Riis et al. 1997; Johnson et al. 1998; Johnson and Lott 1999; Johnson and Lott 2000; Johnson and Lott 2001; Johnson et al. 2002; Lott et al. 2003b). Mean catch per unit effort (CPUE) values for all species, for 2003, were not significantly different from 2002 values (Johnson et al. 2002). Mean gizzard shad CPUE for 2003, at 6.3 fish/net-night was not significantly different than the 2002 value of 3.3 fish/net night or the five year average of 5.8 fish/net-night, due to high sample variances. Mean gizzard shad CPUE in the gill net survey has varied between 0.3 and 51.5 fish/net night during the 1982-2003 survey period and is highly dependent on the number of shad produced the previous year that overwintered and if age-0 shad are long enough to be captured in 13-mm mesh at the time the gill net survey is conducted. Walleye and channel catfish mean CPUE in the 2003 gill net survey were similar at 19.6 and 18.7 fish/net-night, respectively, and higher than all other species sampled (Table 3; Figure 2).

Eight species of age-0 fishes and six species of small prey fishes were collected during the 2003 standard seining survey in early August (Table 4). Gizzard shad mean CPUE in seine haul catches decreased from 1,459.7 fish/haul in 2002 to 244.4 fish/haul in 2003; the fourth lowest since initiation of the seining survey in 1982. While gizzard shad seine haul CPUE decreased from 2002 to 2003, shad were still the most abundant species in seine haul catches, and were followed by emerald shiners and yellow perch, in terms of mean CPUE (Table 4). Emerald shiner mean seine haul CPUE decreased from 46.6 fish/haul in 2002 to 15.1 fish/haul in 2003.

Population Parameters for Walleye

Walleye ranging from 107 to 637 mm TL (Figure 3) were collected during the August 2003 gill net survey. The 2003 walleye mean CPUE of 19.6 walleye/net-night in the standard gill-net survey was not significantly different from the 5-year average of 24.6 walleye/net-night but was at the low end of values documented for the 5-year period. (Table 3). Based on age interpretation from scale samples, the 2000-year class comprised 44% of the walleye catch, followed by the 2001- and 1999-year-classes at 26% and 13%, respectively (Table 5). However, when ages were interpreted from otolith samples, the percentage of fish from the 2000 year class was 33%, while the 1998, 1999 and 2001 year classes comprised 8%, 19%, and 23%, of the total sample, respectively (Table 5). Mean CPUE of age-0 walleye was high in 1994 and 1995 (Figure 4) and these year classes were still represented in the walleye population, as was evident from the 2003 walleye population age-structure based on otolith age interpretation (Table 5).

Table 3. Mean catch per unit effort for fish species collected with standard gill net sets in Lake Sharpe, South Dakota, 1999-2003. Trace (T) indicates values >0.0 but <0.05. Standard error values are in parentheses.

Species	Year				
	1999	2000	2001	2002	2003
Bigmouth buffalo	0.0	T	T	0.0	T
Black bullhead	0.0	T	0.0	0.0	0.0
Black crappie	0.0	0.0	0.0	0.1 (0.1)	0.0
Bluegill	0.0	T	0.0	0.0	0.0
Channel catfish	9.2 (0.6)	11.9 (2.3)	9.0 (1.7)	20.1 (4.5)	18.7 (3.8)
Chinook salmon	0.0	0.0	0.0	0.0	0.0
Common carp	2.4 (0.4)	2.0 (0.6)	1.9 (0.6)	1.4 (0.3)	0.8 (0.3)
Freshwater drum	1.0 (0.3)	0.8 (0.3)	1.7 (0.5)	1.7 (0.7)	0.9 (0.4)
Gizzard shad	3.1 (0.6)	2.4 (1.1)	13.7 (4.9)	3.3 (1.5)	6.3 (3.6)
Goldeye	2.6 (0.7)	1.5 (0.7)	1.5 (0.8)	1.9 (1.0)	0.4 (0.2)
Northern pike	0.2 (0.1)	T	0.1 (0.1)	T	0.0
Rainbow smelt	0.1 (0.1)	T	0.0	0.0	0.0
Rainbow trout	0.0	0.1 (0.1)	T	0.0	T
River carpsucker	0.8 (0.3)	1.5 (0.6)	1.7 (0.5)	0.1	0.3 (0.2)
Sauger	4.2 (0.4)	7.1 (1.8)	5.2 (1.5)	5.6 (1.3)	2.4 (0.6)
Shorthead redhorse	0.7 (0.2)	0.5 (0.2)	0.3 (0.1)	0.5 (0.2)	0.4 (0.2)
Shortnose gar	0.1 (0.1)	0.2 (0.2)	0.1 (0.1)	T	T
Shovelnose sturgeon	0.8 (0.3)	0.4 (0.2)	0.8 (0.7)	0.8 (0.4)	0.1 (0.1)
Smallmouth bass	0.6 (0.3)	0.8 (0.5)	0.9 (0.7)	T	0.3 (0.2)
Smallmouth buffalo	T	T	0.0	0.0	0.0
Spottail shiner	0.1 (0.1)	0.0	T	0.0	0.0
Walleye	25.4 (0.9)	25.8 (4.5)	28.3 (5.4)	24.1 (5.1)	19.6 (3.0)
White bass	2.5 (0.4)	2.7 (1.2)	2.8 (1.4)	3.7 (1.3)	9.8 (6.8)
White crappie	0.3 (0.2)	0.9 (0.7)	0.2 (0.2)	0.1 (0.1)	0.2 (0.1)
White sucker	0.1 (0.1)	0.0	0.1 (0.1)	0.0	0.0
Yellow perch	2.3 (0.4)	1.8 (0.8)	1.3 (0.5)	1.6 (0.6)	1.1 (0.5)

Length at annulus (Table 6) and growth increment estimates (Table 7) calculated from scale samples for walleye collected in 2003 (representing 2002-2003 growth) were comparable to length and growth increments calculated for walleye collected in the 2002 survey, (representing 2001-2002 growth). Walleye growth rates for Lake Sharpe are generally similar to walleye growth rates for Lake Francis Case (Stone and Sorensen 2003). Both Lakes Sharpe and Francis Case have gizzard shad as the main prey fish for walleye (Wolf et al. 1994; Stone and Sorensen 2001). Mean back-calculated length at annulus values generated from scale analysis, for walleye in Lake Sharpe (Table 6), are generally lower than mean values for South Dakota and the Missouri River reservoirs (Willis et al. 2001) though higher than the unweighted mean reported by Carlander (1997) for Michigan, Minnesota, and Wisconsin.

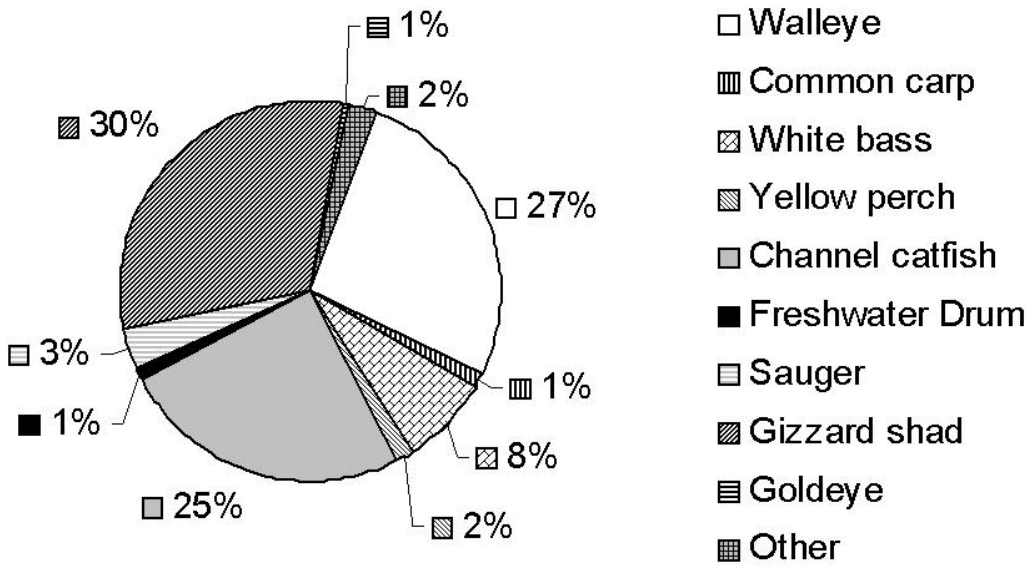

Figure 2. Relative species composition of fish collected from Lake Sharpe, South Dakota, during the August 2003 gill-net survey.

Examination of the length frequency histogram for the 2003 walleye gill net sample (Figure 3), in association with age structure (Table 5) and mean length at age at time of capture data (scales and otoliths, Table 8), suggests the majority of walleyes between 340 and 380-mm in length are from the 2000 and 2001 year classes (age-2 and age-3 fish). However, scale and otolith data provide different results for which year classes are associated with fish between 381 and 457-mm in length in the 2003 gill net survey. If otolith age structure (Table 5) and growth data (Table 8) are referenced, the majority of fish longer than 457-mm were from the 1995 and 1994 year classes (age-8 and age-9 fish), whereas scale data suggests these fish are from the 1997 and 1996 year classes (age-6 and age-7 fish). Mean length at age at time of capture estimates, based on otolith age interpretation, are lower for fish in the 2003 sample than in the 2002 sample (Table 8). This trend was not evident from age interpretation from scales.

Scale and otolith samples were both collected from walleye in the 2003 standard gill net survey and ages determined for individual fish were compared to assess trends in age determination among structure type. Ages determined from scales and otoliths for individual fish agreed 100% of the time for fish aged as age-1 for scales, and agreed 77%, 56% and 55% of the time for fish aged as age 2, 3, and 4 from scales, respectively (Table 9). However, percent agreement for between structures decreased to 29% for fish aged age-5 from scales. Scales tended to under-estimate ages of walleyes aged as age-5 and older from otoliths, possibly because outside annuli on scales are reabsorbed during periods of slow or negative growth.

Table 4. Mean catch per seine haul for fish species in Lake Sharpe, South Dakota, 1999-2003. Catches are for age-0 fishes, except where noted. Standard error values are in parentheses.

Species	Year				
	1999	2000	2001	2002	2003
Bigmouth buffalo	0.0	0.1 (0.1)	0.0	0.0	0.0
Black crappie	0.5 (0.4)	0.0	0.0	0.0	0.0
Bluegill	8.8 (1.4)	0.1 (0.1)	0.0	0.1 (0.1)	0.0
Bluntnose minnow*	0.1 (0.1)	0.5 (0.4)	1.2 (0.8)	5.0 (2.6)	0.0
Brassy minnow*	0.0	0.0	0.1 (0.1)	0.0	0.1 (0.1)
Channel catfish	0.1 (0.1)	0.1 (0.1)	0.0	0.1 (0.1)	0.0
Common carp	0.0	0.0	0.8 (0.4)	0.0	0.2 (0.1)
Emerald shiner*	30.4 (1.9)	16.8 (5.4)	72.4 (30.6)	46.6 (15.3)	15.1 (5.7)
Fathead minnow*	0.1 (0.1)	0.0	0.2 (0.1)	0.6 (0.5)	0.1 (0.1)
Freshwater drum	0.8 (0.4)	0.5 (0.2)	11.8 (6.4)	3.8 (1.7)	0.3 (0.2)
Gizzard shad	696.6 (10.8)	791.6 (393.6)	603.6 (241.8)	1,459.7 (644.7)	244.4 (105.1)
Goldeye	0.4 (0.2)	0.0	0.3 (0.3)	0.0	0.0
Johnny darter*	0.0	0.4 (0.2)	0.1 (0.1)	0.1 (0.1)	0.9 (0.8)
Largemouth bass	1.9 (0.7)	0.0	0.1 (0.1)	0.1 (0.1)	0.0
River carpsucker	0.1 (0.1)	0.0	4.4 (1.6)	3.6 (2.1)	0.0
Sauger	0.0	0.1 (0.1)	0.0	0.0	0.0
Smallmouth bass	4.6 (0.8)	2.5 (0.9)	1.4 (0.7)	3.4 (1.0)	1.8 (0.7)
Smallmouth buffalo	0.8 (0.4)	10.2 (6.7)	0.0	0.0	0.0
Spottail shiner*	11.9 (0.9)	18.3 (6.5)	13.9 (3.5)	4.9 (2.5)	8.7 (3.3)
Walleye	0.8 (0.3)	11.8 (5.2)	3.6 (1.8)	1.6 (0.7)	0.3 (0.2)
White bass	3.8 (0.6)	31.0 (17.5)	14.6 (5.0)	14.9 (9.2)	2.2 (1.1)
White crappie	0.0	0.9 (0.6)	2.1 (0.9)	0.4 (0.3)	0.3 (0.3)
White sucker	0.0	0.1 (0.1)	0.3 (0.2)	0.0	0.1 (0.1)
Yellow perch	4.7 (0.5)	121.0 (102.5)	6.4 (2.3)	10.9 (4.3)	15.9 (12.3)

*includes all ages

Table 5. Age distributions of walleyes collected from Lake Sharpe, South Dakota, with variable-mesh gill nets, 1997-2003, as determined from scales and otoliths. Mean age excludes age-0 fish.

Year	Age														Mean
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
Scales															
1997	2	24	206	214	14	15	16	12	1	0	0	0	0	0	2.8
1998	3	22	42	234	147	23	19	14	7	0	0	0	0	0	3.5
1999	9	135	108	48	203	64	23	9	4	0	0	0	0	0	3.1
2000	12	61	270	57	78	74	22	7	2	2	0	0	0	0	2.9
2001	11	113	135	285	49	30	38	10	4	1	0	0	0	0	2.9
2002	1	58	135	148	137	48	20	18	8	4	0	0	0	0	3.2
2003	11	35	124	208	61	14	8	5	1	1	0	0	0	0	2.9
Otoliths															
2002	1	57	153	140	141	29	4	19	23	1	2	5	0	0	3.0
2003	11	34	110	157	88	38	8	3	8	7	2	1	2	1	3.1

Table 6. Mean back-calculated total lengths (mm) at annulus for each year class of walleye in Lake Sharpe gill-net catches, 2003, as determined from scales.

Year class	Age	N	Annulus								
			1	2	3	4	5	6	7	8	9
2002	1	35	148								
2001	2	124	195	287							
2000	3	208	189	294	352						
1999	4	61	177	269	334	375					
1998	5	14	221	310	363	412	440				
1997	6	8	232	317	372	418	447	470			
1996	7	5	188	280	354	403	436	462	486		
1995	8	1	195	324	371	424	461	514	552	567	
1994	9	1	284	400	501	557	573	598	610	623	632
All classes			203	310	378	431	471	511	550	595	632
N		457									

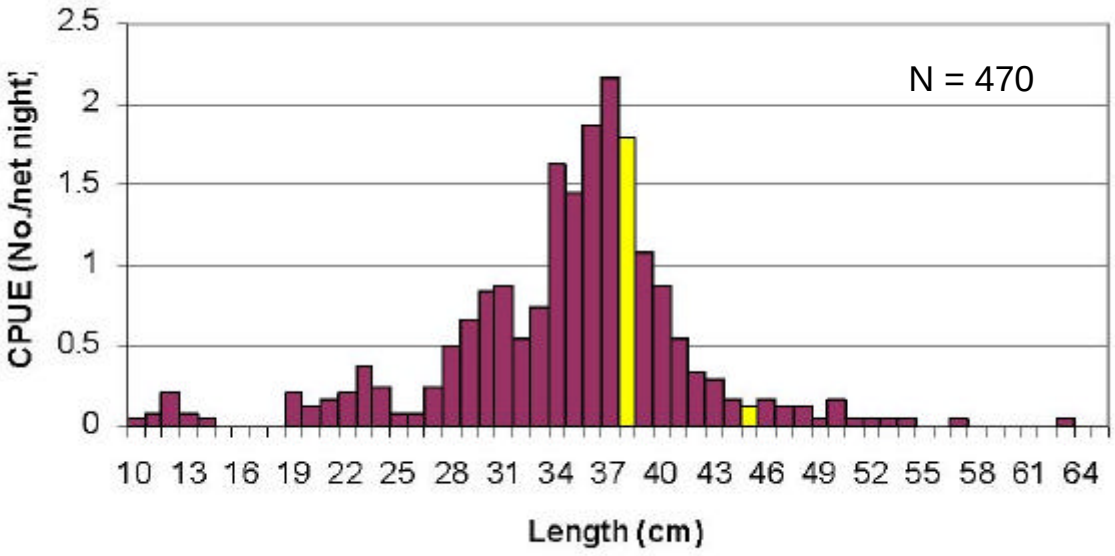

Figure 3. Length frequency of walleye collected in standard gill-net sets in Lake Sharpe, South Dakota, during August 2003. The lighter bars on the histogram correspond to the 38-cm (minimum length) and 45-cm (one-over length) length groups.

Table 7. Average annual increments (mm) of back-calculated lengths at annulus for each year class of walleye in Lake Sharpe gill-net catches, 2003, as determined from scales.

Year class	Age	N	Growth period (ages)								
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
2002		35	148								
2001		124	195	92							
2000		208	189	105	58						
1999		61	177	92	65	41					
1998		14	221	89	53	49	28				
1997		8	232	85	55	46	29	23			
1996		5	188	92	74	49	33	26	24		
1995		1	195	129	47	53	37	53	38	15	
1994		1	284	116	101	56	16	25	12	13	9
All classes N			203	107	68	53	40	40	39	45	37

Table 8. Mean walleye length at time of capture (August) as determined from scales and otoliths, for fish captured during the 2002 and 2003 standard coolwater gill net surveys.

Structure	Year		Length at age at capture (mm)								
			1	2	3	4	5	6	7	8	9
Scales	**2002**	**N**	50	101	127	120	46	20	17	7	4
		Mean	242	319	368	410	448	469	494	522	545
Otoliths	**2002**	**N**	44	99	96	83	15	2	11	16	1
		Mean	247	327	373	410	424	459	489	492	495
Scales	**2003**	**N**	35	124	208	61	14	8	5	1	1
		Mean	227	319	371	392	453	480	497	574	637
Otoliths	**2003**	**N**	22	95	131	76	37	7	3	8	7
		Mean	224	311	362	385	410	426	439	480	469

Table 9. Comparison of walleye ages determined from interpretation of scale and otolith growth patterns for walleye collected in the August 2003 gill net sample.

Age determined from otoliths	Age determined from scales										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	22										
2		83	12								
3		22	101	8							
4		3	48	24	1						
5			16	17	4						
6			2	4	1						
7				1	1	1					
8					2	4	2				
9					4	2	1				
10							1		1		
11					1						
12						1	1				
13								1			
14											

Walleye *Wr* values in Lake Sharpe in 2003 were lower than other years in the 1997-2003 period (Table 10), possibly due to low production of age-0 gizzard shad in 2003 (Table 4). Relative weight values for stock-to-quality-length walleyes collected in the 2003 gill net survey were significantly higher than those of quality-preferred and preferred-length fish, with *Wr* decreasing with increasing length (Table 10). Mean Wr values of 72 for quality-preferred- and 66 for preferred-length walleyes may be indicative of slow growth during 2003 and a lack of replacement of fish harvested in 2003 for the 2004 fishing season.

The walleye survival rate estimate from catch-curve analysis of pooled 2002-2003 data from scale analysis, was similar to other estimates except the estimate for 1999-2000 pooled data (Table 11). The 1999-2000 pooled data estimate of survival may have been low because of the inclusion of a strong 1998 year class in calculations (Table 11). The annual survival rate estimate from catch-curve analysis, for pooled 2002-2003, from otolith analysis, was 63%, substantially higher than the 49% survival estimated from scale data.

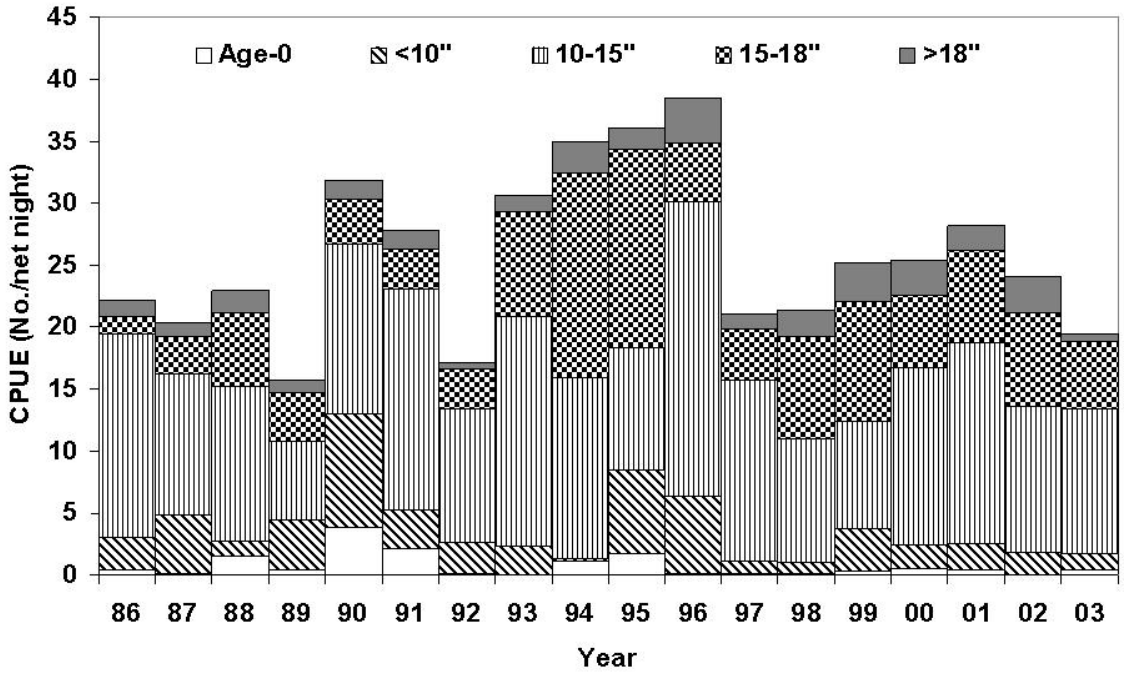

Figure 4. Size structure and abundance (CPUE) of walleye collected in the standard gill-net survey in Lake Sharpe, SD, during August, 1986-2003.

Walleye population PSD in the 2003 gill net survey, at 34, was within the balanced range of 30-60 (Table 12; Anderson 1978). The 2003 PSD value of 34 was the lowest of the 1997-2003 period. Proportional stock density decreased from 47 in 2002 to 34 in 2003 because abundance of fish of quality length decreased during this period, but abundance of stock-to-quality length fish was unchanged (Figure 4).

Walleye Recruitment Assessment

The mean 2003 nighttime electrofishing CPUE value of 19.7 walleye/h was not significantly different from values for 1996, 1999, 2001, and 2002 at the p=0.05 level of significance (Table 13). Mean CPUE values for 1995, 1997, 1998, and 2000 were all significantly higher than the 2003 value. Mean length of age-0 walleye captured during fall electrofishing in 2003, at 166 mm, was similar to the value for 2001 (Table 13). The highest CPUE existed for Joe Creek (75.3 fish/h), of the six standard locations sampled during 2003. Inside of LaFramboise Island produced the second highest CPUE of 2003 at 17.3 fish/h and CPUE of age-0 walleye at Farm Island was uncharacteristically low, at 1.6 fish/h.

Table 10. Mean relative weight (*Wr)*, by length class, for Lake Sharpe walleye and sauger, 1997-2003. N is the number of fish used in calculations. Within length classes, values with the same letter code are not significantly different from one another at the *P*=0.05 level.

Walleye								
Year	Stock-Quality		Quality-Prefer.		Preferred		Total	
	N	Wr	N	Wr	N	Wr	N	Wr
1997	337	82 b	139	79 c	4	76 ab	480	81 ab
1998	224	86 c	254	82 b	10	77 a	488	84 a
1999	207	84 a	294	81 b	18	76 ab	519	82 a
2000	324	82 b	188	78 d	18	71 b	530	80 b
2001	386	87 c	229	83 b	9	75 ab	624	85 a
2002	284	83ab	243	81 b	13	73 b	539	82 a
2003	280	78 d	140	72 d	6	66 c	426	75 c
Sauger								
Year	Stock-Quality		Quality-Prefer.		Preferred		Total	
	N	Wr	N	Wr	N	Wr	N	Wr
1997	0	----	38	79 b	34	77 a	72	78 b
1998	0	----	26	81 ab	51	79 a	77	80 a
1999	26	83 b	14	86 c	61	77 a	101	80 a
2000	26	86 b	83	82 a	52	72 b	161	79 a
2001	27	81 b	69	77 b	28	75 ab	124	77 b
2002	4	80 b	76	78 b	58	72 b	138	76 b
2003	0	----	38	69 d	19	64 c	57	68 c

Table 11. Estimates of annual survival (S), annual mortality (A), and instantaneous mortality (Z) rates, for walleye captured in the Lake Sharpe gill-net survey, as determined from scale and otolith age interpretation. Years indicates which years of annual coolwater gill net survey data were combined for analysis.

Years	S	A	Z
Scales			
1996-1997	0.45	0.55	0.81
1997-1998	0.48	0.52	0.73
1998-1999	0.45	0.55	0.79
1999-2000	0.37	0.63	1.00
2000-2001	0.48	0.52	0.73
2001-2002	0.49	0.51	0.71
2002-2003	0.49	0.51	0.71
Otoliths			
2002-2003	63	37	0.47

Table 12. Walleye and sauger proportional stock density (PSD) and relative stock density (RSD-P and RSD-M) values for gill net samples, from 1997-2003, for Lake Sharpe, South Dakota.

Year	Walleye			Sauger		
	PSD	RSD-P	RSD-M	PSD	RSD-P	RSD-M
1997	30	1	0	100	47	1
1998	54	2	0	100	66	1
1999	60	3	0	75	61	2
2000	38	3	0	82	32	4
2001	38	1	0	78	23	2
2002	47	2	0	97	42	2
2003	34	1	0	100	33	2

Table 13. Mean nighttime electrofishing catch per unit effort (CPUE; No./h) and length (mm) for age-0 walleye collected during September 1995-2003 on Lake Sharpe, SD. S.E. denotes standard error values about means and N is sample size.

Year	Catch per Unit Effort (No./h)			Mean length (mm)		
	N	CPUE	S.E.	N	Length	S.E.
1995*	18	59.6	11.6	268	175	1.2
1996*	18	22.4	3.4	101	136	2.9
1997*	18	42.7	9.7	197	142	1.6
1998#	22	42.2	10.4	236	146	1.2
1999+	36	20.1	2.9	181	130	1.3
2000+	36	75.1	8.6	522	147	0.7
2001+	36	22.9	4.1	321	164	1.1
2002+	36	12.6	2.6	113	147	1.6
2003^	36	19.7	5.7	177	166	0.2

* North Shore, Joe Creek and Farm Island
\# North Shore, Joe Creek, Farm Island and Degrey
\+ North Shore, Joe Creek, Farm Island, Degrey, LaFram. Bay and stilling basin
^ North Shore, Joe Creek, Farm Is., Ft. George, LaFram. Bay and Stilling Basin

Potential early indicators of walleye year class strength were compared to mean age-1 gill net CPUE to determine which indicators or surveys were the best early indicators of walleye recruitment. Potential indicators of walleye recruitment and values for the 1994-2003 period are listed in Table 14. Summer age-0 seining CPUE and fall age-0 walleye electrofishing CPUE, for the 1995-2003 period, were not significantly correlated with CPUE of age-1 walleye in the standard gill net survey the next year (P=0.27, r=0.41, $d.f.$=8 and P=0.07, r=0.68, $d.f.$=7, respectively). However, walleye age-0 gill net CPUE was significantly positively correlated with walleye age-1 gill net CPUE the next year (P=0.0.003, r=0.85, $d.f.$=8).

Length of age-0 walleye during August, when the standard gill net survey is conducted, varies greatly among years and may affect gill netting efficiency

for age-0 walleye (Hamely 1975). Overwinter survival of age-0 walleye may also be related to size of age-0 walleye during the fall (Chavalier 1973; Forney 1976; Forney 1980; Madenjian 1991). Therefore, multiple correlation analyses were conducted using age-0 seining or age-0 nighttime electrofishing CPUE and mean length of age-0 walleye in the fall nighttime electrofishing survey (as an index of gill netting efficiency) as independent variables and age-1 gill net CPUE as the dependent variable. Though not significant at the P=0.05 level, more of the variation in age-0 gill net CPUE was explained by adding mean length of age-0 walleye in the nighttime electrofishing survey to either seining or nighttime electrofishing CPUE of age-0 walleye (P=0.16, r=0.73, $d.f.$=8 and P=0.09, r=0.79, $d.f.$=8, respectively) than simply comparing age-0 gill net CPUE with either age-0 walleye seining or nighttime electrofishing CPUE in linear regression analyses. Therefore, conducting the seining and fall nighttime electrofishing surveys for age-0 walleye may help determine the presence of an initially strong walleye year class, when a low mean length of age-0 walleye in August results in low gill netting efficiency of age-0 walleye.

Table 14. Mean age-0 walleye seine haul catch-per-unit-effort (CPUE; No./haul), mean standard gill net age-0 walleye CPUE (No./net night), mean age-0 walleye nighttime electrofishing CPUE (No./h), and mean standard gill net age-1 walleye CPUE (No./ net night) for the 1994-2003 walleye year classes, in Lake Sharpe, SD.

Year Class	Seine Age-0 CPUE	Gill net Age-0 CPUE	Electrofishing Age-0 CPUE	Gill net Age-1 CPUE
1994	5.9	1.50	----	12.96
1995	2.5	1.63	59.6	7.89
1996	2.2	0.11	22.4	1.00
1997	1.1	0.08	42.7	0.92
1998	6.9	0.13	42.2	5.63
1999	0.8	0.38	20.1	2.65
2000	11.8	0.52	75.1	4.71
2001	3.6	0.46	22.9	2.42
2002	1.6	0.04	12.6	1.46
2003	0.3	0.46	19.7	----

Population Parameters for Sauger

Four year classes of sauger were collected with gill nets in Lake Sharpe in 2003 (Table 15). Lengths of sauger collected in the August gill-net survey ranged from 282 to 514 mm TL (Figure 5). Age-3 sauger (2000 year class) comprised 51% of the catch in 2003, as determined from age interpretation of scale samples. Age-2 and age-4 sauger (2001 and 1999 year classes, respectively) comprised 39% and 9% of the sauger gill net catch in 2003 (Table 15). Sauger Wr values in 2003, for all incremental length groups sampled, were significantly lower than all other years in the 1997-2003 period (Table 10) and as for walleye, are likely related to low production of age-0 gizzard shad during 2003 (Table 4). Proportional stock density and RSD-P values for the 2003 sauger gill net sample, at 100 and 33, respectively, were within the range of values calculated for standard surveys in the 1997-2003 period (Table 12). The 2003 PSD value of 100 reflects the lack of sauger younger than age-2 in the 2003 gill net sample (Table 12) and the fact that age-2 sauger had surpassed 300-mm in length by August 2003

(Tables 16 and 17). All of the sauger captured during the 2003 gill net survey were longer than stock length (200 mm; Figure 5). Mean sauger CPUE in the August 2003 gill net survey was the lowest value of the 1999-2003 period (Table 3), at 2.4 fish/net-night but was not significantly different from other values in the 1999-2003 period because of high sample variance (Table 3).

Table 15. Age distributions of sauger collected from Lake Sharpe, South Dakota, with variable-mesh gill nets, 1997-2003. Mean age excludes age-0 fish and age structure was determined from scale (1997-2003) and otolith (2002-2003) analysis.

Year	Age										
	0	1	2	3	4	5	6	7	8	9	Mean
Scales											
1997	0	0	8	45	15	4	0	0	0	0	3.2
1998	0	0	1	31	39	5	1	0	0	0	3.7
1999	0	26	13	11	35	16	0	0	0	0	3.0
2000	0	7	100	15	12	28	1	0	0	0	2.7
2001	0	20	25	73	2	4	1	0	0	0	2.6
2002	0	1	54	32	37	10	2	2	0	0	3.1
2003	0	0	22	29	5	0	1	0	0	0	2.8
Otoliths											
2002	0	1	41	17	25	6	1	0	7	5	2.9
2003	0	0	2	21	16	8	0	0	0	2	3.9

Table 16. Mean back-calculated total lengths (mm) at annulus for each year class of sauger in Lake Sharpe gill net catches, 2003, as determined from scales.

Year class	Age	N	Annulus					
			1	2	3	4	5	6
2002	1	0	---					
2001	2	22	169	315				
2000	3	29	157	290	361			
1999	4	5	173	293	341	383		
1998	5	0	---	---	---	---	---	
1997	6	1	198	369	408	442	486	507
All Classes			174	317	370	412	486	507
N		57						

Table 17. Average annual increments (mm) of back-calculated lengths at annulus for each year class of sauger in Lake Sharpe gill-net catches, 2003, as determined from scales.

Year class	Age	N	Growth period (ages)					
			0-1	1-2	2-3	3-4	4-5	5-6
2002	1	0	---					
2001	2	22	169	146				
2000	3	29	157	133	71			
1999	4	5	173	120	48	42		
1998	5	0	---	---	---	---	---	
1997	6	1	198	171	39	34	44	21
All Classes			174	143	53	42	74	21
N		57						

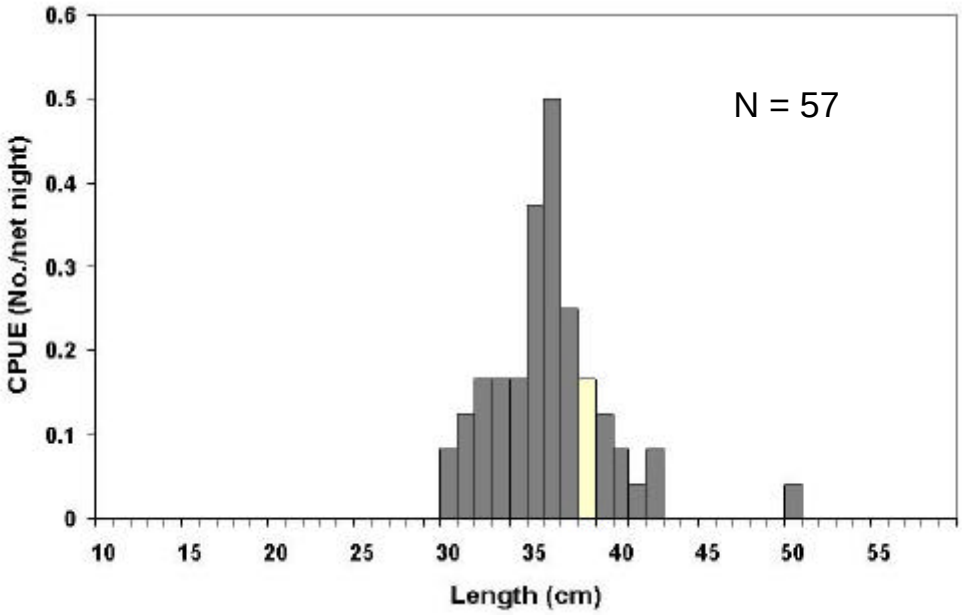

Figure 5. Length frequency of sauger collected during the standard gill-net survey during August 2003, on Lake Sharpe, South Dakota. The lighter bar on the histogram corresponds to the 38-cm (minimum length) length groups.

Population Parameters for Channel Catfish

Channel catfish population indices, such as PSD, RSD-P, RSD-M, and *Wr*, exhibited little change during the 1997-2003 period (Table 18), possibly due to slow growth and low annual mortality (Table 19). Growth rates of channel catfish in Lake Sharpe have decreased since impoundment of the reservoir in 1963 (Elrod 1974). Elrod (1974) documented a gradual reduction in channel catfish growth rates during the first eight years following impoundment of the reservoir. Mean length-at-age-at-time-of-capture estimates for age-10

and age-15 channel catfish were 437 and 599 mm, respectively, in 1971 (Elrod 1974), and 406 and 555 mm, respectively, in 2003

Table 18. Channel catfish proportional stock density (PSD), relative stock density of preferred and memorable-length (RSD-P and RSD-M) fish, and relative weight (*Wr*) for 1997-2003, from Lake Sharpe, South Dakota. Mean *Wr* values for 2002 and 2003 are for stock-length fish only.

Year	PSD	RSD-P	RSD-M	Wr	N
1997	35	3	0	85	108
1998	37	6	0	83	108
1999	41	4	0	83	139
2000	34	5	0	82	148
2001	27	2	0	82	135
2002	30	1	0	80	171
2003	27	3	0	79	193

Table 19. Mean back-calculated total lengths (mm) at annulus for each year class of channel catfish in Lake Sharpe gill-net catches, 2003. Length-at-annulus values are not listed for annuli above 14 even though channel catfish to age 20 were captured in the survey. Channel catfish age structure for the 2003 gill net sample is also presented.

Year class	Age	N	Length at annulus (mm)													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
2001	2	1	65	155												
2000	3	3	78	161	274											
1999	4	10	68	114	170	247										
1998	5	26	67	113	158	213	269									
1997	6	75	67	113	182	231	280	313								
1996	7	18	67	115	179	230	270	303	333							
1995	8	9	69	118	179	232	259	276	299	320						
1994	9	3	72	127	226	278	298	314	327	339	354					
1993	10	6	72	138	210	260	396	340	358	373	388	396				
1992	11	16	80	139	206	271	320	359	393	416	433	452	467			
1991	12	8	83	116	172	227	277	302	329	358	378	392	412	426		
1990	13	8	96	152	228	294	335	379	403	428	455	475	494	514	530	
1989	14	5	91	166	268	340	393	418	450	475	499	516	536	556	572	587
1988	15	2	87	115	191	264	320	358	371	395	421	442	457	474	491	508
1987	16	2	91	159	216	276	318	365	398	432	467	489	520	537	555	563
1986	17	2	113	162	239	294	338	379	405	442	468	495	504	522	539	555
1985	18	1	94	142	244	337	358	425	448	468	484	492	501	510	533	554
1984	19	1	78	99	123	158	239	324	386	405	444	471	502	508	519	526
1983	20	1	91	149	189	226	281	341	386	426	467	479	521	552	588	618
N		197	0	1	3	10	26	75	18	9	3	6	16	8	8	5
Total/mean			80	134	203	258	304	347	378	406	438	464	491	511	541	559
Standard error			3	5	9	11	10	11	12	13	13	12	12	14	11	14
Length increment			54	69	55	46	43	31	28	32	25	28	20	20	18	14

Population Age Structure

Number at age/year class																		
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
01	00	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83
3	10	23	62	171	44	24	8	16	32	16	17	11	3	3	4	3	2	1

Mean back-calculated length at annulus values generated from assessing ages of pectoral spines, and the associated gill net sample age structure, are presented in Table 19. As is typically the case, no age-1 channel catfish were captured in the standard August gill net survey (Table 19). Channel catfish to age 20 were collected in the 2003 gill net survey. Using the age structure generated from pectoral spine analysis, for age 6 through age-20 fish, the estimated mortality rate for channel catfish was 24%, using Ricker's equation (Ricker 1975), a value similar to estimates generated by Elrod (1974) for the Lake Sharpe channel catfish population during the first eight years of impoundment.

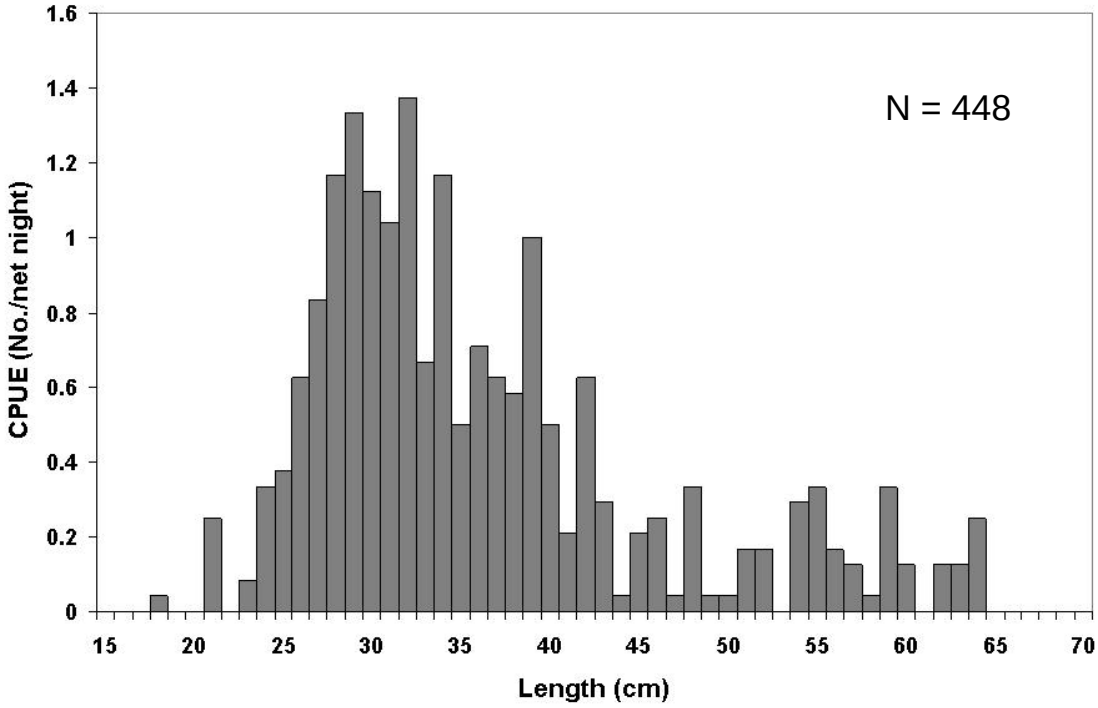

Figure 6. Length frequency of channel catfish collected during the standard gill-net survey during August 2003, on Lake Sharpe, South Dakota.

Population Parameters for Smallmouth Bass

Beginning in 2002, one rip-rap (Bid Bend Dam) and one natural reservoir habitat area (Joe Creek) have each been sampled every week to 10 days during late-May and early-June, by nighttime electrofishing. Data collected during 1993, 1994, 2001,and 2002 is included for comparison with 2003 data (Table 20). For all years in the 2001-2003 period, CPUE values were significantly higher at Big Bend Dam than Joe Creek (Table 20). However, PSD and RSD-P values and sample size structure (Figure 7) were lower for Big Bend Dam samples than Joe Creek samples. This pattern of higher catch rates and lower stock density indices values and size structure for rip-rap sampling areas was also documented for Lake Oahe (Lott 1996, Lott 2000).

Mean back-calculated length at annulus values for 2003 electrofishing samples (Table 21) of smallmouth bass were lower than for the 2002 electrofishing sample (Lott et al. 2003b) for age-3 and older fish. Mean back-calculated length at age 4 for the 1999 year class in the 2003 Lake Sharpe sample was 243 mm, compared to 313 mm and 315 mm for age-4 fish in the 2002 and 2001 samples, respectively (Johnson et al. 2002). Mean back-calculated length of age-4 smallmouth bass in the 2001 and 2002 Lake Sharpe electrofishing samples at 313 and 315 mm, was similar to the Statewide and Missouri River reservoir means (Willis et al. 2001). The 2003 mean back-calculated length at age 4, at 243 mm, was significantly lower than the Statewide and Missouri River reservoir means. This discrepancy in mean length of age-4 smallmouth bass among years highlights the need to compare scales, as an aging method, with otoliths and opercular bones to adequately estimate smallmouth bass growth rates, especially in relation to the 306- to 457-mm (12-18-inch) protected slot regulation currently in effect for smallmouth bass.

Table 20. Mean smallmouth bass electrofishing catch-per-unit effort (CPUE; No./h) and stock density indices values for spring, nighttime electrofishing samples at Joe Creek and Big Bend Dam.

Location	Year	N	CPUE	SE	Ns	PSD	RSD-P	RSD-M
Joe Creek	2001	6	16.7	6.9	56	91	54	7
	2002	18	12.4	2.1	24	88	25	4
	2003	18	16.2	3.7	68	50	21	1
Big Bend Dam	1993	12	52.0	14.3	75	21	1	0
	1994	12	47.0	17.3	64	38	11	3
	2001	9	42.2	17.2	75	39	8	0
	2002	18	51.1	16.3	208	46	11	0
	2003	18	65.8	24.1	211	31	1	0

Table 21. Mean back-calculated total lengths (mm) at annulus and length increments for each year class of smallmouth bass collected from Lake Sharpe by nighttime electrofishing and angling, 2003, as determined from scales.

Year class	Age	N	Annulus							
			1	2	3	4	5	6	7	8
2002	1	59	117							
2001	2	109	109	174						
2000	3	116	116	176	221					
1999	4	105	105	155	207	243				
1998	5	109	109	167	226	274	307			
1997	6	117	117	178	244	303	345	375		
1996	7	123	123	181	246	296	337	365	392	
1995	8	122	122	193	232	276	309	341	376	403
Total/mean		366	115	175	229	278	325	360	384	403
Standard error			2	4	6	10	10	10	8	0
Length increment			60	54	49	46	35	24	19	

Smallmouth bass mean *Wr* values for the 2003 electrofishing sample, for all incremental length groups, were lower than in 2001 and 2002 (Table 22). As for the 2001 and 2002 samples, mean *Wr* values for the 2002 sample generally decreased with increasing length. During 2003, *Wr* values for predator species relying on fish as their main prey (walleye, sauger, smallmouth bass, and white bass), decreased significantly from values documented for all previous sampling years (Tables 10 and 22, Appendix 3), possibly due to the low abundance of age-0 gizzard shad in 2003 (Table 4).

Table 22. Mean relative weight (*Wr)*, by length class, for Lake Sharpe smallmouth bass collected by electrofishing and angling during May and June of 2001-2003. N is the number of fish used in calculations. Values with the same letter code, within a year, are not significantly different from one another at the *P*=0.05 level.

Year	Sub-stock		Stock-to-Quality		Quality-to-Preferred		Preferred-to-Memorable		Memorable-to-Trophy	
	N	Wr	N	Wr	N	Wr	N	Wr	N	Wr
2001	11	98a	31	96a	61	93b	110	87c	24	78d
2002	2	111a	26	102b	70	98c	68	96d	7	86e
2003	40	93a	150	90b	45b	91c	17	80d	1	63e

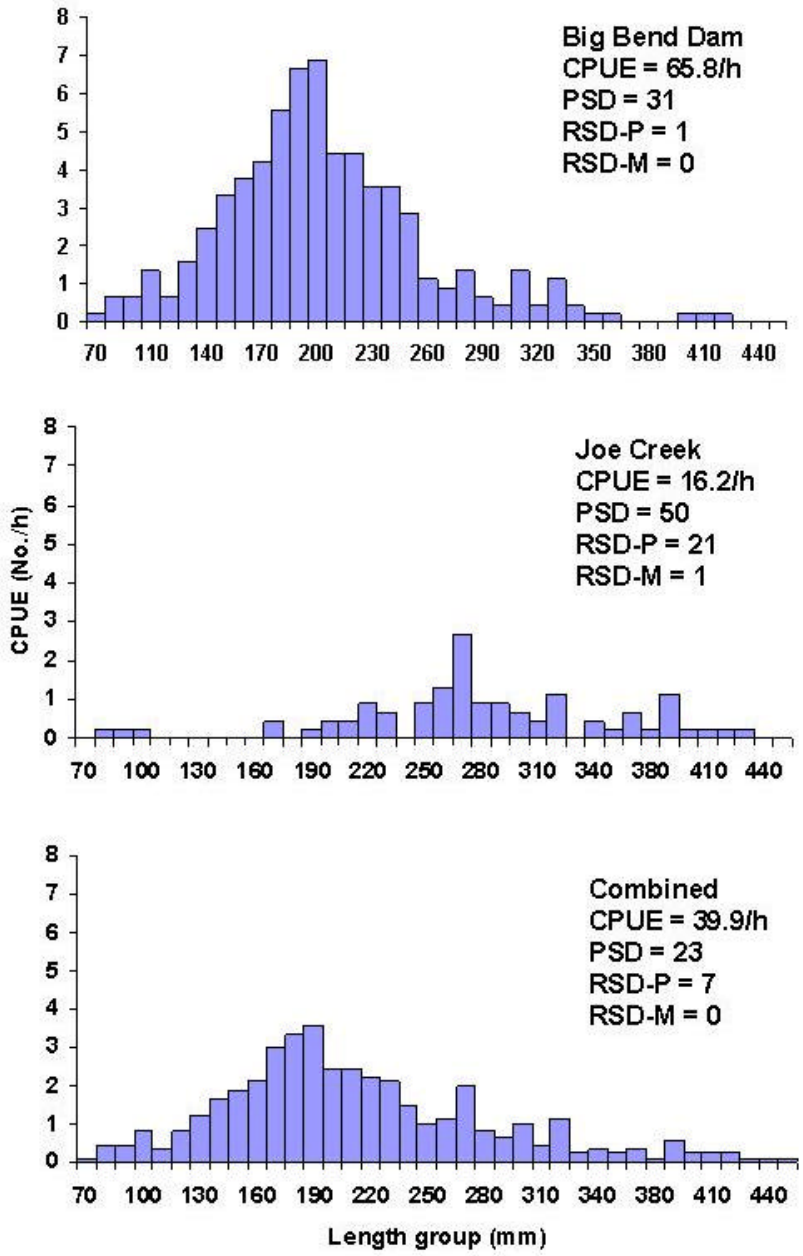

Figure 7. Length frequency of smallmouth bass collected during the standard May-June nighttime electrofishing survey, 2003, on Lake Sharpe, South Dakota.

A 306- to 457-mm (12- to 18-inch) protected slot length limit regulation was placed in effect January 1, 2003 for smallmouth bass on Lake Sharpe. In addition to the protected slot, anglers are allowed at most one smallmouth bass equal to or longer than 457-mm as part of the five-fish daily limit. Data on smallmouth bass growth, condition, and exploitation will be used along with other population survey data (age-0 seining CPUE) and angler use, harvest and preference data, to determine the effects of regulations implemented in 2003.

RESERVOIR-WIDE ANGLER USE AND HARVEST SURVEY

Fishing Pressure

Estimated fishing pressure for the April-September 2003 daylight period on Lake Sharpe was 397,220 h, similar to the 2002 estimate of 385,357 h (Table 23) and within the range of estimates generated for other surveys. Estimated fishing pressure during the April-September daylight period peaked during May in 2003 and fishing pressure was highest in the lower zone of the reservoir (Table 24). Approximately 53% of the 397,220 angler-h estimated for the April-September 2003 daytime period were spent on lower Lake Sharpe, while 37% and 9% of total angler hours were spent on upper and middle Lake Sharpe, respectively.

Table 23. Angler use and harvest estimates from surveys conducted during daylight hours, April-September on Lake Sharpe, South Dakota.

Year	Fishing pressure (h)	Angler trips	Fish harvest (No.)	Walleye harvest (No.)	Reference
1973-1974	208,800	46,400	76,813	62,479	Schmidt (1975)
1984	241,986	52,605	87,020	64,784	Riis (1986)
1985	274,376	62,358	123,942	66,584	Riis (1986)
1991	303,381	70,554	143,307	93,027	Fielder et al. (1992)
1992	402,543	100,636	219,152	157,220	Stone et al. (1993)
1993	291,970	60,827	102,833	83,133	Stone et al. (1993)
1994	347,125	91,752	152,981	130,009	Riis & Johnson (1995)
1995	356,391	122,893	166,949	140,943	Riis et al. (1996)
1996	477,220	101,536	170,568	142,506	Riis et al. (1997)
1997	442,827	100,097	191,079	159,274	Johnson et al. (1998)
1998	502,631	111,696	252,496	207,144	Johnson et al. (1999)
1999	386,315	84,784	186,720	155,724	Johnson and Lott 2000
2000	325,532	71,893	144,730	104,076	Johnson and Lott 2001
2001	300,078	77,141	126,382	95,044	Johnson et al. 2002
2002	385,357	89,827	210,781	144,065	Lott et al. 2003b
2003	397,220	99,627	157,150	111,938	This study

The percentage of the total fishing pressure for middle Lake Sharpe in 2003 was substantially lower than during previous years in which angler use and harvest surveys were conducted (Lott et al. 1994; Riis and Johnson 1995; Riis et al. 1996; Riis et al. 1997; Johnson et al. 1998; Johnson and Lott 1999; Johnson and Lott 2000; Johnson and Lott 2001; Johnson et al. 2002; Lott et al. 2003b). However, this decrease in fishing pressure for middle Lake Sharpe may be the result of a change in creel survey design rather than an actual shift in fishing pressure. Prior to 2003, fishing pressure was estimated using aerial boat and shore angler counts. A bus route survey design was implemented for 2003 and fishing pressure was estimated from access-based counts of boat trailers and shore anglers. The aerial counts of boats fishing Lake Sharpe recorded the boats in the zone where they were fishing while the bus route's access-based pressure counts recorded boats where they were launched. The middle zone of Lake Sharpe has only two commonly used boat ramps (Farm Island and Fort George) and the majority of boats fishing the middle zone of the reservoir launch at ramps in the upper zone. Therefore, when the methodology used to estimate fishing pressure was changed from an aerial method to an access-based method, pressure estimates shifted from the middle to the upper zone of Lake Sharpe.

Table 24. Estimated total fishing pressure (angler hours), by month and zone, on Lake Sharpe, South Dakota, 2003.

Zone	Month						Total
	April	May	June	July	August	Sept.	
Upper	30,552	37,262	25,466	24,777	13,478	18,262	149,796
95% CI	16,206	15,262	8,557	9,718	5,766	7,480	27,430
Middle	5,846	7,985	5,281	4,815	3,626	8,467	36,021
95% CI	5,243	2,960	1,820	2,586	1,529	4,027	8,050
Lower	5,578	59,012	56,331	42,414	40,421	7,647	211,403
95% CI	2,908	27,571	19,656	16,000	12,563	3,677	40,107
Total	41,977	104,259	87,079	72,006	57,525	34,375	397,220
95% CI	17,279	31,652	21,515	19,579	13,907	9,257	49,252

Estimated shore angler hours for the April-September 2003 period were higher than values generated for the same periods of 1999-2002 and represented a higher percentage of total angler hours than from 1999-2002 (Table 25). Again, the documented increase in shore angler hours, from the 1999-2002 period to 2003, may be partially a result of the change in creel survey design, with the bus route design more accurately documenting shore angler use and harvest. Estimated fishing pressure for the April-September 2003 period, expressed as hours per hectare, was 16.8 h/ha, similar to 2002 and within the range of values observed during the 1997-2003 period (Table 25).

Table 25. Estimated total angler hours, for boat and shore fishing and methods combined, for Lake Sharpe, South Dakota, April-September, 1997-2003.

Year	Boat		Shore		Combined	
	Total angler hours	No. h/ha	Total angler hours	No. h/ha	Total angler hours	No. h/ha
1997	370,045	15.6	72,782	3.1	442,827	18.7
1998	438,303	18.5	64,328	2.7	502,631	21.2
1999	345,601	14.6	40,714	1.7	386,315	16.3
2000	295,639	12.5	29,893	1.3	325,532	13.8
2001	266,857	11.3	33,221	1.4	300,078	12.7
2002	353,248	14.7	32,109	1.3	385,357	16.0
2003	345,135	14.6	52,084	2.2	397,220	16.8

Fish Harvest

Walleye were the most common species caught by anglers during the April-September 2003 daylight period, followed by white bass, smallmouth bass, channel catfish, sauger, and rainbow trout, in order of decreasing estimated catch (Figure 8, Tables 26 and 27). An estimated 111,938 walleyes were harvested by anglers during the April-September 2003 daytime survey period and an estimated 433,788 walleyes were released. During October 2003, the creel survey was continued in the upper and middle zones of Lake Sharpe. An estimated 12,140 walleyes were harvested and 19,777 walleyes released from the upper and middle reservoir zones during the daylight hours of October 2003.

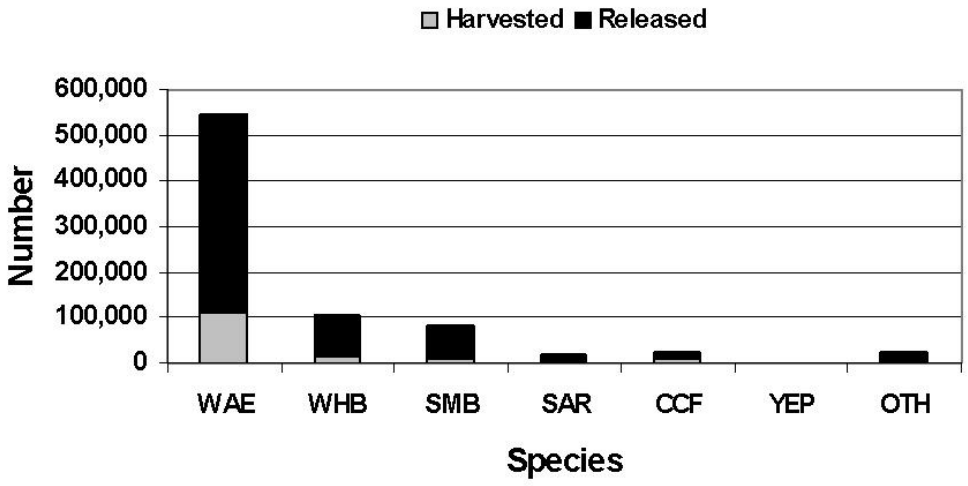

Figure 8. Estimated sport-fish harvest from Lake Sharpe, South Dakota, during April-September, 2003 (801,812 fish caught).

Estimated walleye and smallmouth bass harvest, for the April-September 2003 period, was highest in the lower zone of Lake Sharpe, while harvest of sauger, channel catfish, white bass, and rainbow trout was highest in the upper zone of the reservoir (Table 28). Approximately 93% of the smallmouth bass harvested were from the lower zone of Lake Sharpe and 100% of the rainbow trout harvest occurred in the upper zone. Channel catfish harvest was distributed throughout all reservoir zones.

The percentage of angling parties harvesting a limit decreased in 2003 from previous years and was the lowest of the 1997-2003 period, at 9% (Table 29). The percentage of angling parties harvesting zero walleyes per trip in 2003, was the highest of the 1997-2003 period, at 56%. The percentage of anglers specifically fishing for walleyes during the April-September 2003 survey period was 63%, the lowest value of the 1997-2003 period (Table 30).

Table 26. Total estimated fish harvest, by month, for anglers fishing Lake Sharpe, South Dakota, 2003. Species abbreviations used appear in Appendix 1.

Species	Month							
	April	May	June	July	August	Sept.	Oct.*	Total
WAE	10,985	28,397	11,103	39,482	15,407	6,563	12,140	124,078
95%CI	4,474	11,435	3,055	15,157	8,214	2,925	5,260	22,216
SAR	410	1,927	1,172	1,108	360	59	60	5,096
95%CI	398	2,162	897	934	333	82	67	2,575
WHB	383	6,593	3,112	1,486	1,946	726	128	14,374
95%CI	399	5,328	2,965	1,208	2,135	756	204	6,631
SMB	41	2,017	2,453	2,223	801	224	33	7,792
95%CI	107	1,381	2,372	1,521	621	236	64	3,210
CCF	639	2,294	2,839	2,043	2,707	786	145	11,452
95%CI	514	4,363	1,573	1,300	3,466	1,604	154	6,171
RBT	5,109	124	148	0	0	12	90	5,483
95%CI	5,786	168	404	0	0	26	125	5,804
YEP	27	147	182	185	195	6	33	775
95%CI	47	186	171	283	193	11	64	433
OTH	0	265	316	87	62	0	0	728
95%CI	0	---	---	---	---	---	---	---
TOTAL	17,593	41,764	21,325	46,614	21,478	8,377	12,628	169,778
95%CI	7,899	12,632	7,212	18,025	7,154	3,422	5,499	26,306

Other (OTH) includes black crappie, bluegill, common carp, freshwater drum, goldeye, largemouth bass, white crappie, northern pike, shovelnose sturgeon, shortnose gar, river carpsucker, white sucker, black bullhead, smallmouth buffalo, and bigmouth buffalo. *The harvest estimates for October are only for the upper and middle zones of Lake Sharpe.

Table 27. Total estimates of fish released, by month, for anglers fishing Lake Sharpe, South Dakota, April-October, 2003. Species abbreviations used appear in Appendix 1.

Species	Month							
	April	May	June	July	August	Sept.	Oct.*	Total
WAE	19,085	109,981	181,040	87,180	20,127	16,373	19,777	453,563
SAR	748	5,043	5,955	733	45	182	29	12,735
WHB	1,321	8,987	58,989	13,605	250	3,049	740	91,377
SMB	471	8,006	29,113	22,885	9,148	2,575	185	72,383
CCF	337	438	2,352	5,309	5,278	1,173	63	14,950
RBT	10,878	248	49	0	0	32	0	11,207
YEP	0	208	397	514	250	187	259	1,815
OTH	182	1,495	1,371	1,337	7,197	540	790	8,475
TOTAL	33,022	134,406	279,266	131,563	42,295	24,111	21,843	666,505

Other (OTH) includes black crappie, bluegill, common carp, freshwater drum, goldeye, largemouth bass, white crappie, northern pike, shovelnose sturgeon, shortnose gar, river carpsucker, white sucker, black bullhead, smallmouth buffalo, and bigmouth buffalo. *The release estimates for October are only for the upper and middle zones of Lake Sharpe.

Table 28. Total estimated fish harvest, by zone, from Lake Sharpe, South Dakota, during April-September, 2003.

Species	Zone			
	Upper	Middle	Lower	Total
Walleye	35,564	10,222	66,152	111,938
Sauger	3,608	348	1,079	5,036
White bass	6,491	3,302	4,452	14,246
Smallmouth bass	539	41	7,180	7,759
Channel catfish	4,617	3,603	3,088	11,307
Rainbow trout	5,394	0	0	5,394
Yellow perch	57	118	567	742
Other	286	356	86	728
Total	**56,556**	**17,990**	**82,604**	**157,150**

Table 29. Percent of angling parties that harvested a limit of walleye, at least three walleye/angler, at least two walleye/angler, etc. from Lake Sharpe, South Dakota, 1997-2003, during the April-September daytime period.

Party success (walleye/angler)	Year						
	1997	1998	1999	2000	2001	2002	2003
Limit (4)	17	26	27	18	12	18	9
3.0 – 3.9	8	10	12	9	8	12	6
2.0 – 2.9	9	10	12	12	7	12	8
1.0 – 1.9	13	13	14	16	15	15	11
0.1 – 0.9	9	10	8	12	13	10	11
0	44	31	27	32	44	33	56

Table 30. Percent of anglers fishing for specified target species, in Lake Sharpe, South Dakota, 1997-2003, during the April-September daytime period.

Target Species	Percent by year						
	1997	1998	1999	2000	2001	2002	2003
Walleye	82	80	86	78	75	80	63
Anything	11	15	11	19	18	17	31
Rainbow Trout	1	2	1	*	4	1	3
White Bass	2	2	*	1	1	1	1
Smallmouth bass	*	*	*	1	1	1	1
Other*	4	1	2	1	1	*	1

* Values >0.5 percent, included with other.

Catch, Harvest and Release Rates

Estimated hourly catch and release rates for all species combined for the April-September 2003 daylight period, at 2.02 fish/h and 1.62 fish/h, respectively were higher than values for the same period in 2002 (Lott et. al 2003b). However, estimated mean harvest rate, for all species combined, decreased from 0.55 fish/h in 2002 to 0.39 fish/h in 2003 (Table 31). The increase in overall catch rate from 2002 to 2003 was due to increases in hourly catch rates of walleye and smallmouth bass during 2003, presumably resulting from a low year of gizzard shad production (Tables 31 and 4). The increase in the release rate was a result of the new 305-457-mm protected slot length limit for smallmouth bass and the size structure of the walleye population in 2003 (Figures 3 and 4). A high percentage of the walleyes in the population in 2003 and in angler catches were less than the 381-mm minimum length limit in effect during all months except July and August. This resulted in the high release rate documented for walleyes and all fish. Hourly catch rates for white bass and channel catfish in 2003 were similar to 2002 (Table 31).

Table 31. Harvest rate, release rate, and catch rate, by species, for all anglers fishing Lake Sharpe, South Dakota, during the daylight hours of April-September, 2003. Trace (T) indicates values >0.0 but <0.005.

Species	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
Walleye	0.282	1.092	1.374
Sauger	0.013	0.032	0.045
White bass	0.035	0.228	0.264
Smallmouth bass	0.020	0.182	0.201
Channel catfish	0.028	0.038	0.066
Rainbow trout	0.014	0.028	0.042
Yellow perch	0.002	0.004	0.006
Other	0.002	0.019	0.021
Species combined	**0.396**	**1.623**	**2.019**

For anglers specifically fishing for a certain species, hourly catch, harvest and release rates were substantially higher than those for all anglers combined (Tables 31 and 32). Anglers specifically fishing for walleyes had a

mean hourly catch rate of 2.25 fish/h for the April-September daylight period (Table 32), while the mean catch rate of walleyes by all anglers was 1.37 fish/h (Table 31). Anglers specifically fishing for smallmouth and white bass had mean hourly catch rates of 1.87 and 2.96 fish/h, respectively.

Table 32. Harvest rate, release rate, and catch rate, by species, for anglers specifically fishing for the species listed on Lake Sharpe, South Dakota, during the daylight hours of April-September, 2003. Trace (T) indicates values >0.0 but <0.005.

Species Targeted	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
Walleye	**0.649**	**1.605**	**2.254**
White bass	1.921	1.034	2.96
Smallmouth bass	0.091	1.780	1.871
Channel catfish	1.858	0.588	2.446
Rainbow trout	0.740	1.529	2.268

Mean hourly catch rates for all species combined (Table 33) followed a typical Lake Sharpe pattern, peaking in June during 2003. However, the mean harvest rate peaked in July, at 0.65 fish/h. Peaks in hourly catch and harvest rates for all species combined are closely tied to walleye catch and harvest rates because the majority of fish caught are walleyes (Tables 27 and 28).

Table 33. Harvest rate, release rate and catch rate for all species by month, for anglers fishing Lake Sharpe, South Dakota, during the daylight hours of April-September, 2003.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.419	0.787	1.206
May	0.401	1.289	1.690
June	0.245	3.207	3.452
July	0.647	1.827	2.475
August	0.373	0.735	1.109
September	0.244	0.701	0.945
October*	0.461	0.798	1.260

* Values for October are only for the upper and middle zones of Lake Sharpe.

Mean catch and harvest rates and mean length and percentage of walleye caught that were harvested, by month, for the April-September daylight period, are listed in Table 34, for 2001-2003. October data is included for the upper and middle zones of Lake Sharpe for 2003. Colby (1979) stated an hourly catch rate of 0.3 walleye/h was excellent for walleye fisheries and mean hourly catch rates for Lake Sharpe exceeded 0.3 walleye/h for all months surveyed in the 2001-2003 period except April 2002 (Table 34). Anglers fishing Lake Sharpe have traditionally harvested approximately one walleye for every three hours fished (Johnson and Lott 1999; 2000; 2001; Johnson et al. 2002; Lott et al. 2003b) and the 2003 mean hourly harvest rate of 0.28 fish/h is similar to this value. The mean catch rate peaked during June in

2003 at 2.21 walleye/h but mean harvest rate and percentage of walleyes caught that were kept were the lowest during June for the April-September period. The percentage of walleyes caught by anglers that are between 305- and 381-mm in length generally increases in late May and remains high through early September. The presence of these fish in the population is documented in walleye population length frequency histograms for the 2002 (Lott et al 2003) and 2003 (Figures 3 and 4) standard gill net surveys conducted in August. Walleyes <381-mm in length were well represented in the angler harvest in July and August 2003, when the minimum length limit was not in effect, comprising 76% and 72% of the walleye harvest during those months, respectively (Figure 9).

Mean walleye catch and harvest per trip values for 2001-2003, for the April-September daylight period, are presented in Table 35. During the 2001-2003 standard survey period, mean trip length has ranged between 3.9 h and 4.3 h. Therefore, differences in catch and harvest per trip frequencies among months and years are more a result of changes in hourly catch and harvest rates than trip length.

Table 34. Estimated angler catch and harvest rates (walleye/angler-h) for walleye, the associated mean length of walleye harvested, and percent of walleye caught that were kept, for the daylight hours of April-October 2001-2003, for Lake Sharpe, South Dakota.

Month	Catch rate			Harvest rate			Mean length harvested (mm)			Percent kept		
	2001	**2002**	**2003**	**2001**	**2002**	**2003**	**2001**	**2002**	**2003**	**2001**	**2002**	**2003**
April	0.59	0.24	0.72	0.23	0.20	0.26	417	413	418	39	76	36
May	1.23	0.63	1.33	0.38	0.31	0.27	427	416	413	31	49	21
June	2.21	1.51	2.21	0.25	0.37	0.13	417	406	419	12	22	6
July	1.17	1.32	1.76	0.56	0.61	0.55	361	378	368	48	46	31
August	0.83	0.85	0.62	0.46	0.48	0.27	364	379	364	55	57	43
Sept.	0.32	0.71	0.67	0.09	0.28	0.19	410	412	408	28	39	29
Oct.*	----	----	1.17	----	----	0.44	----	----	412	----	----	37
Total	**1.16**	**0.99**	**1.37**	**0.32**	**0.37**	**0.28**	**382**	**397**	**391**	**27**	**38**	**21**

*Values for October 2003 are only for the upper and middle zones of Lake Sharpe and are not included in calculations of total values.

Mean walleye catch per trip generally peaks in June (Table 35), when catch rates of walleyes <381-mm in length have increased from April and May values due to an increase in water temperature and metabolic rates, and a low abundance of available prey resources. Mean catch per trip in July 2003 was high, at 7.1 walleye/trip, and is believed to be associated with high hourly catch rates of walleye resulting from a late gizzard shad spawning season.

Table 35. Mean walleye catch and harvest per angler trip, by month and zone, for the April-October 2003 daylight survey period for Lake Sharpe, South Dakota.

Catch per angler trip								
Year	Month							
	April	May	June	July	August	Sept.	Oct.	Total
2001	1.6	5.3	10.1	3.1	3.2	1.6	---	4.5
2002	0.9	2.6	6.3	4.8	4.1	3.8	---	4.2
2003	2.8	5.7	7.7	7.1	2.3	3.6	5.7	5.4

Harvest per angler trip								
Year	Month							
	April	May	June	July	August	Sept.	Oct.	Total
2001	0.6	1.7	1.2	1.5	1.8	0.4	---	1.23
2002	0.7	1.3	1.4	2.2	2.3	1.5	---	1.60
2003	1.0	1.2	0.4	2.2	1.0	1.0	2.1	1.12

*Values for October 2003 are only for the upper and middle zones of Lake Sharpe.

Mean walleye harvest per trip generally peaks in July or August because the 381-mm minimum length limit is not in effect and a high percentage of the angler catch and harvest during these months is of walleyes <381-mm in length (Figure 9). During 2003, mean catch per trip peaked in June at 7.7 walleye/trip but mean harvest per trip in June, at 0.4 walleye/trip, was the lowest of the April-September period (Table 34), due to the 381-mm minimum length limit..

Lengths of Fish Harvested

Length frequency distributions of walleyes harvested each month during the April-October 2003 daylight period illustrate standard trends for Lake Sharpe (Figure 9). Between 90 and 97% of the walleyes harvested during the months that the 381-mm minimum length limit was in effect were between 381 and 457-mm in length (15 and 18 inches). During July and August, when no minimum length limit was in effect, 22-27% of the walleyes harvested were between 381 and 457-mm in length and 72-76% were less than 381-mm. The percentage of walleyes longer than 457-mm in length in the angler harvest was highest in April and June, at approximately 10% and lowest in July and August, with <1% of the harvested walleyes measured being ≥457-mm in length.

Length frequency histograms for smallmouth bass measured in the angler harvest in 2003, illustrate the effects of the 305-457-mm protected slot length limit placed in effect for 2003 (Figure 10). For the April-September daylight survey period, approximately 89% of the smallmouth bass harvested were <305-mm in length and 4% were ≥457-mm in length. Approximately 7% of the smallmouth bass measured during angler interviews were within the protected slot length limit.

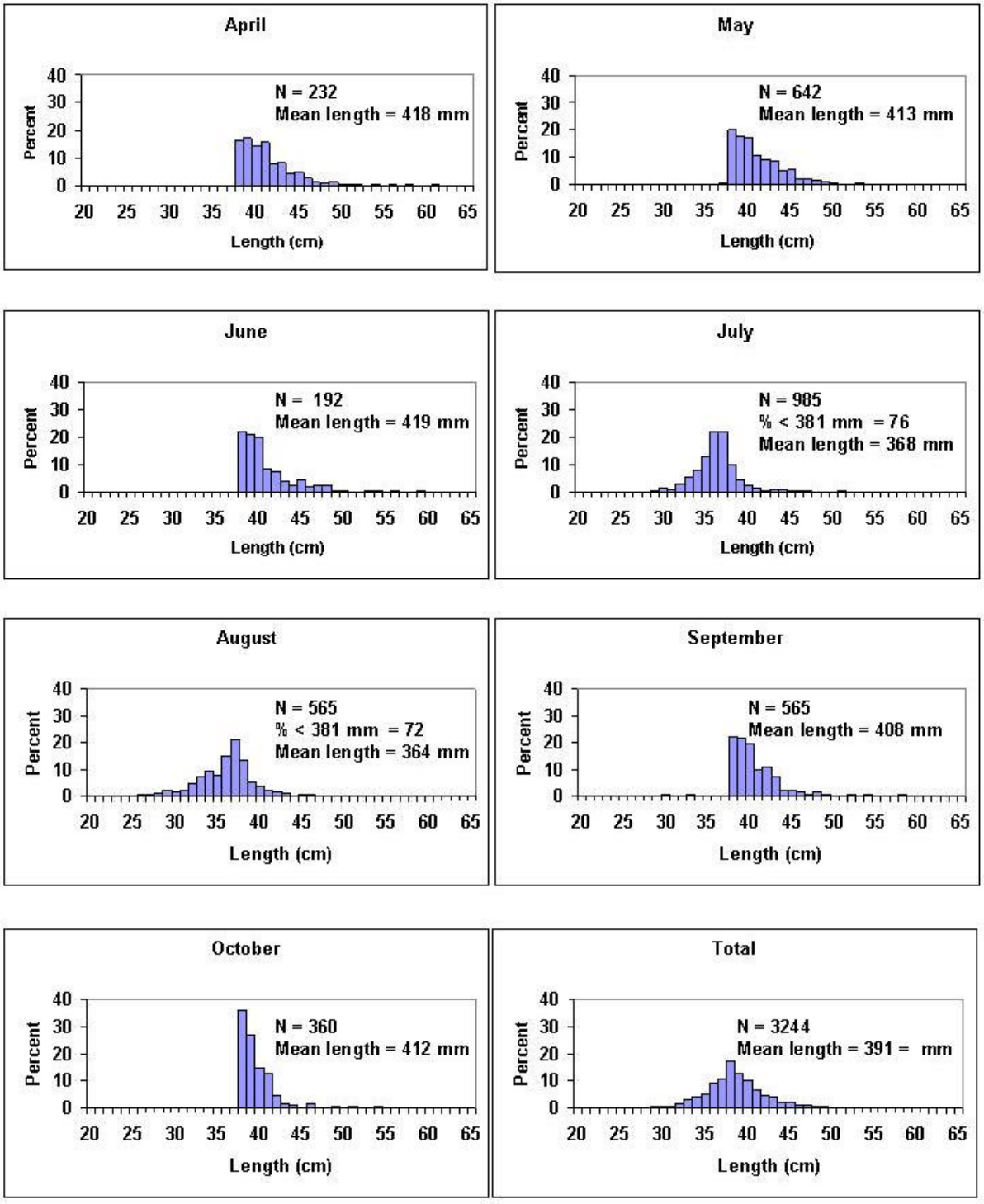

Figure 9. Monthly length frequencies of walleye harvested by anglers from Lake Sharpe, South Dakota, 2003.

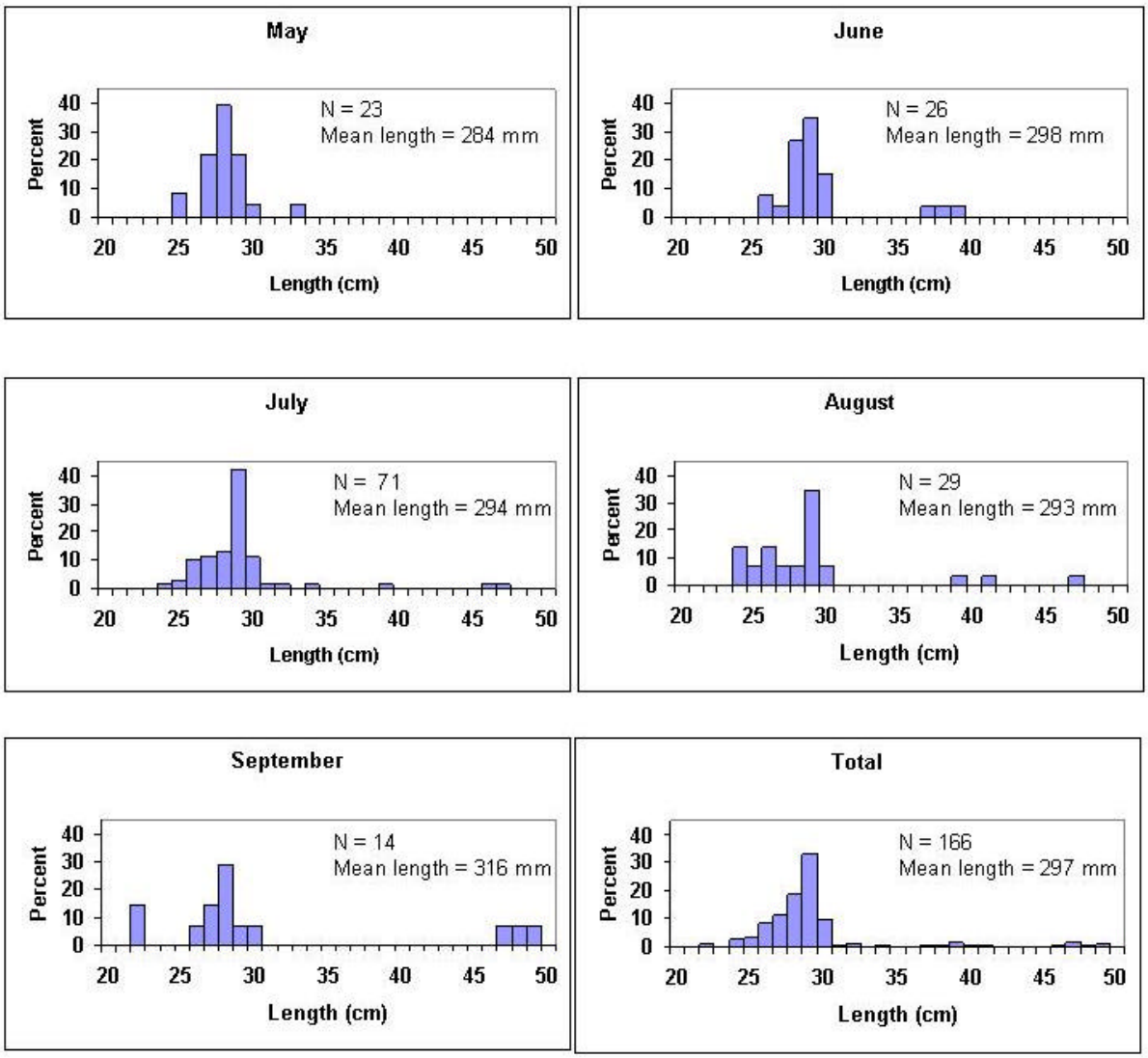

Figure 10. Monthly length frequencies of smallmouth bass harvested by anglers from Lake Sharpe, South Dakota, 2003.

Angler Demographics and Economics

The average fishing party during the April-September 2003 standard reservoir-wide survey was 2.3 people and the average trip length was 4.1 h. Residents made approximately 79% of angler trips on Lake Sharpe during the April-September 2003 daylight period. Almost half (48%) of angler trips during this period were made by residents of Hughes County. Minnehaha, Beadle, Stanley, and Pennington were the only other South Dakota counties comprising >5% of the total trips on Lake Sharpe during the April-September period (Figure 11).

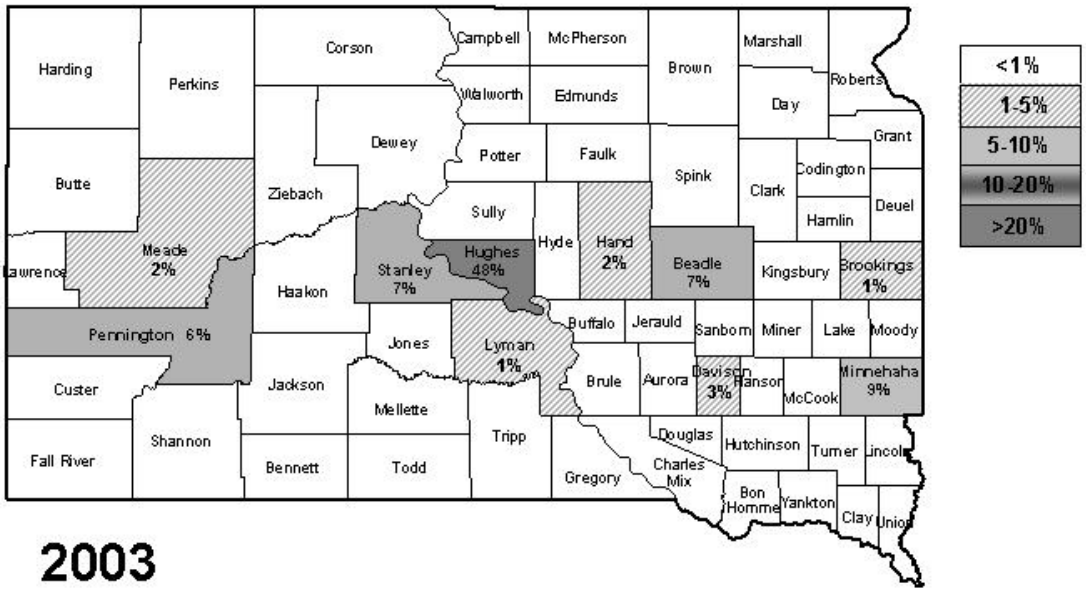

Figure 11. County of residence for resident anglers fishing Lake Sharpe during the April-September 2003 daylight period.

Of the total estimate of non-resident angler trips on Lake Sharpe, percentages of anglers from Iowa, Nebraska, Minnesota, Wisconsin, Colorado, and Wyoming, were within the range observed in previous years (Table 36). However, the percentage of non-resident angler trips by Iowa anglers decreased from 2002 to 2003, while the percentage of Minnesota anglers increased.

Table 36. Percent of total non-resident angler contacts from various states, fishing Lake Sharpe, South Dakota, 1998-2003.

State	Percent by year					
	1998	1999	2000	2001	2002	2003
Iowa	38	29	33	32	35	27
Nebraska	22	30	18	21	24	25
Minnesota	23	22	16	26	17	23
Colorado	3	4	8	4	4	5
Wisconsin	1	3	3	4	3	3
Wyoming	2	2	2	1	2	1
Others*	6	5	20	12	15	15

* Alaska, Arizona, Arkansas, California, Florida, Illinois, Indiana, Kansas, Missouri, Montana, Nevada, New Hampshire, New Jersey, New York, North Dakota, Oklahoma, Pennsylvania, Texas, Tennessee, Vermont, and Virginia.

The pattern in percentage of anglers traveling certain distances to fish Lake Sharpe changed from 2002 to 2003, reflecting the 48% of angler trips by residents of Hughes County (Table 37, Figure 4). The percentage of angler trips by anglers traveling in excess of 200 miles one way, to fish Lake Sharpe, decreased accordingly.

Table 37. Percentages of anglers traveling the specified distances, one way, to fish Lake Sharpe, South Dakota, during April-September 1998-2003.

Distance (miles)	Percent by year					
	1998	1999	2000	2001	2002	2003
<25	31	30	23	38	27	40
25-50	6	8	8	4	7	7
51-100	11	13	11	8	8	9
101-200	27	22	17	24	20	17
200+	25	26	41	26	38	26

Anglers answering interview questions were asked their age as part of the 2003 angler use, harvest, and preference survey on Lake Sharpe. Only 4% of anglers participating in angler interviews during the April-September 2003 daytime period were less than 20 years old (Table 38). Anglers between age 35 and 54 comprised 46% of anglers participating in angler interviews during 2003.

Table 38. Age frequency of anglers answering attitude, preference, and satisfaction questions during angler interviews on Lake Sharpe during the April-September 2003 daylight survey period. T (trace) indicates values >0.0 but <0.05.

Age group (years)	Number	Percent of total
0-4	0	0
5-9	5	0
10-14	23	2
15-19	21	2
20-24	29	3
25-29	68	7
30-34	99	10
35-39	116	12
40-44	120	12
45-49	113	11
50-54	115	11
55-59	85	8
60-64	81	8
65-69	58	6
70-74	49	5
75-79	16	2
80 and older	3	0

For the April-September 2003 daylight period, Lake Sharpe anglers contributed approximately 7.5 million dollars to local economies, based on an estimated 99,627 trips (Table 23) at an estimated $75 per trip for South Dakota's Missouri River reservoirs (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 1997).

ANGLER SATISFACTION, PREFERENCE, AND ATTITUDE SURVEY

Angler Trip Satisfaction

How anglers feel about their fishing experience is important to the success of a fishery. Angler responses help fisheries managers determine if current management practices and regulations are providing a fishery that meets angler needs and expectations.

In terms of rating a trip based on catching the numbers of fish they were expecting, median angler trip ratings for 2003 were generally “fair” (median=3), with the median value being “fair” (median=3) in April and August (Table 39). Median trip rating based on numbers of fish anglers were expecting to catch decreased from 2 “good” in 2002 to “fair” in 2003, even though catch per trip increased from 2002 to 2003 (Table 35). When the average number of walleye harvested per angler was factored in, trip rating based on numbers of fish anglers were expecting generally improved as the average number of fish harvested per angler increased. Angling parties averaging 0 walleye harvested per angler had a median trip rating response of “poor” while parties harvesting a limit of walleye had a median trip rating of “good” (Table 40).

Table 39. Responses of Lake Sharpe anglers during 2003 who were asked the question: “How would you rate your fishing today in terms of catching the numbers of fish you were expecting?” 1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = very poor, and 6 = no opinion. N is sample size and does not include “no opinion” responses.

Month	Rating your trip in terms of the numbers of fish you were expecting							
	1	2	3	4	5	6	N	Median
April	9	8	10	14	15	6	56	**4**
May	18	23	24	21	11	7	97	**3**
June	6	13	22	14	18	4	73	**3**
July	11	17	16	6	9	4	59	**3**
August	4	11	9	12	15	9	51	**4**
Sept.	4	14	17	10	13	4	58	**3**
Total	**52**	**86**	**98**	**77**	**81**	**34**	**394**	**3**
Percent	**13**	**22**	**25**	**20**	**21**			

Median trip rating based on sizes of fish anglers were expecting to catch, was “fair” (median = 3) during all months surveyed during 2003 (Table 41). When the average number of walleye harvested per angler was factored in, the median trip rating for angler parties averaging 0-1.9 walleye harvested per angler was “fair”, while the median trip rating for parties averaging 4 walleye harvested per angler was “good” (Table 42).

Table 40. Responses of Lake Sharpe anglers during 2003 who were asked the question: "How would you rate your fishing today in terms of catching the numbers of fish you were expecting?" compared to the average number of walleye harvested per angler. Response categories are the same as in Table 39. N is sample size and does not include "no opinion" responses.

Walleye /angler	Rating your trip in terms of the numbers of fish you were expecting						
	1	2	3	4	5	N	Median
0	13	31	54	55	54	207	**4**
0–0.9	4	9	18	6	13	50	**3**
1–1.9	7	10	10	7	6	40	**3**
2-2.9	6	16	7	5	2	36	**2**
3-3.9	10	7	4	2	4	27	**2**
4	12	11	5	2	2	32	**2**

Table 41. Responses of Lake Sharpe anglers during 2003 who were asked the question: "How would you rate your fishing today in terms of catching the sizes of fish you were expecting?" Response categories are the same as in Table 39. N is sample size and does not include "no opinion" responses.

Month	Rating your trip in terms of the sizes of fish you were expecting							
	1	2	3	4	5	6	N	Median
April	9	12	9	16	12	11	58	**3**
May	17	19	27	13	13	11	89	**3**
June	13	11	26	10	11	8	71	**3**
July	7	13	18	15	9	3	62	**3**
August	2	8	22	6	20	8	58	**3**
Sept.	13	7	15	8	13	5	56	**3**
Total	**61**	**70**	**117**	**68**	**78**	**46**	**394**	**3**
Percent	**15**	**18**	**30**	**17**	**20**			

Table 42. Responses of Lake Sharpe anglers during 2003 who were asked the question: "How would you rate your fishing today in terms of catching the sizes of fish you were expecting?" compared to the average number of walleye harvested per angler. Response categories are the same as in Table 39. N is sample size and does not include "no opinion" responses.

Walleye /angler	Rating your trip in terms of the sizes of fish you were expecting						
	1	2	3	4	5	N	Median
0	27	34	65	42	51	219	3
0–0.9	6	7	14	6	8	41	3
1–1.9	9	10	13	7	9	48	3
2-2.9	6	4	10	5	3	28	3
3-3.9	4	3	4	5	0	16	3
4	9	11	8	3	6	37	2

When anglers were asked to consider all factors when stating their level of satisfaction with their fishing trip, the median trip rating for the April-September period was “slightly satisfied”(median of 3, Table 43), a decrease from the 2002 median value “moderately satisfied” (median of 2, Lott et al. 2003b). Sixty percent of angling parties indicated some degree of satisfaction, a value below the Lake Sharpe Strategic Plan objective of 70%. As when rating a trip based on numbers or sizes of fish anglers were expecting, overall trip satisfaction increased as the average number of walleye harvested per angler increased (Table 44).

Table 43. Responses of Lake Sharpe anglers during 2003 who were asked the question: “Considering all factors, how satisfied are you with your fishing trip today?” 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral (neither satisfied or dissatisfied, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include “no opinion” responses.

Month	Satisfaction rating								N	Median
	Satisfied			Neutral	Dissatisfied			N.O		
	1	2	3	4	5	6	7	8		
April	9	5	4	6	8	5	5	2	42	**4**
May	16	18	19	10	6	3	4	3	76	**3**
June	5	12	13	11	3	5	2	2	51	**3**
July	9	17	7	3	2	2	3	0	43	**2**
August	9	9	7	6	3	3	3	0	40	**3**
Sept.	5	3	9	7	4	4	4	5	36	**4**
Total	**53**	**64**	**59**	**43**	**26**	**22**	**21**	**12**	**288**	**3**
Percent		**60**		**15**		**24**				

Table 44. Responses of Lake Sharpe anglers during 2003 who were asked the question: “Considering all factors, how satisfied are you with your fishing trip today?” compared to the average number of walleye harvested per angler. N is sample size and does not include “no opinion” responses. Response categories are the same as in Table 43.

Walleye /angler	Satisfaction rating							N	Median
	Satisfied			Neutral	Dissatisfied				
	1	2	3	4	5	6	7		
0	20	27	28	24	19	13	14	145	3
0–0.9	2	10	8	10	0	4	3	37	3
1–1.9	5	2	8	0	5	3	1	24	3
2-2.9	3	6	6	5	0	2	2	24	3
3-3.9	9	4	2	2	0	0	0	17	1
4	13	12	4	2	2	0	0	33	2
Percent		**60**		**15**		**24**			

Decreases in median trip ratings and the percentage of anglers satisfied with their fishing trip from 2002 to 2003 were likely a result of increased hourly catch rates and decreased harvest rates from 2002 to 2003, especially in June (Table 34). This data suggests that when anglers are catching a high number of walleyes per hour fished but the opportunity to harvest fish is low because the majority of fish caught are below the minimum length limit, angler satisfaction and trip ratings are low.

Angler Preferences and Attitudes

Information on what anglers regard as a reasonable annual harvest of walleyes helps biologists understand angler characteristics, beliefs, and perceptions. Therefore, anglers interviewed in 2003 were asked what a reasonable total number of walleyes for one person to keep and eat or give away in a year would be. Approximately 40% of anglers interviewed stated a number between 20 and 39 walleyes, as a reasonable annual harvest, 25% of anglers stated a number between 50 and 99, and 17% stated a number ≥100 (Table 45). When asked how many walleyes they keep and eat or give away in a single year, 40% of respondents again stated they kept between 20 and 39 walleyes in a single year, 22% stated they kept between 50 and 99 walleyes, and 15% stated they kept 100 or more walleyes a year (Table 46). Anglers participating in interviews were asked either the question about a reasonable number of walleyes to harvest in a year or how many walleyes they harvested in a year but not both questions as they appeared on different interview forms. The fact that the frequency distributions for these two question responses are so similar may mean anglers think the number of walleyes they harvest in a year is reasonable.

Table 45. Percent of responses of Lake Sharpe anglers during 2003 who were asked the question: "In your opinion, what would be a reasonable total number of walleyes for one person to keep and eat or give away in a year?" by month. N is sample size.

Number	Month						
	April	May	June	July	August	Sept.	Total
0-9	4	6	0	0	0	2	**2**
10-19	2	3	7	14	11	0	**6**
20-29	22	27	25	21	21	21	**23**
30-39	31	7	18	23	15	13	**17**
40-49	4	9	14	9	8	8	**9**
50-59	16	26	15	11	19	23	**19**
60-69	2	3	3	0	6	4	**3**
70—79	0	1	4	4	2	2	**2**
80-89	2	0	3	0	4	0	**1**
90-99	0	0	0	2	0	0	**0**
100-149	6	6	10	11	9	19	**10**
150-199	4	3	0	4	0	0	**2**
200-249	2	1	1	2	4	2	**2**
250-299	0	0	0	0	0	0	**0**
300+	4	7	0	0	2	6	**3**
N	**49**	**86**	**72**	**56**	**53**	**48**	**364**

Table 46. Percent of responses of Lake Sharpe anglers during 2003 who were asked the question: "About how many walleyes do you keep and eat or give away in a single year?" by month. N is sample size.

Number	Month						
	April	**May**	**June**	**July**	**August**	**Sept.**	**Total**
0-9	7	9	12	0	5	8	**7**
10-19	10	3	8	17	10	5	**8**
20-29	55	21	22	27	15	13	**25**
30-39	12	16	22	12	10	16	**15**
40-49	5	9	6	5	3	16	**7**
50-59	5	9	8	17	18	11	**11**
60-69	0	9	4	2	8	3	**5**
70—79	0	6	2	2	5	5	**4**
80-89	0	3	0	0	5	5	**2**
90-99	0	0	0	0	3	0	**0**
100-149	5	4	12	0	15	8	**7**
150-199	0	4	2	12	3	3	**4**
200-249	2	3	4	2	0	3	**3**
250-299	0	0	0	2	0	0	**0**
300+	0	3	0	0	0	5	**1**
N	**42**	**67**	**51**	**41**	**39**	**38**	**278**

Anglers were also asked how many days they fished in South Dakota in a year and how many of those days were on Lake Sharpe during the 2003 survey (Table 47). Approximately 19% of respondents stated they fished 9 days or less in South Dakota in an average year, 30% of respondents fished 50 or more days, and 11% fished 100 or more days in an average year. When asked how many of these days were spent fishing Lake Sharpe, 38% responded they spent 9 days or less on Lake Sharpe, 17% fished Lake Sharpe 50 or more days, and 4% fished Lake Sharpe 100 or more days in an average year (Table 47).

As an information and education effort, anglers fishing Lake Sharpe during the April-October 2003 period were asked if they new Eurasian Watermilfoil and Curlyleaf Pondweed were found in Lake Sharpe (Table 48). Of the 443 anglers responding to the question, 69% stated they were aware of the presence of the exotic plant species.

Table 47. Percent of responses of Lake Sharpe anglers during 2003 who were asked the question: "On average, about how many days do you fish in South Dakota in a year?" and to the question "How many of those days are on Lake Sharpe?" by month. N is sample size.

Number	Days in South Dakota in a year							Days on Lake Sharpe in a year						
	APR	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**TOT**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**TOT**
0-9	14	17	20	17	19	26	**19**	24	41	39	34	45	39	**38**
10-19	8	11	16	21	21	9	**14**	12	21	18	30	14	15	**19**
20-29	14	18	18	17	7	5	**14**	15	10	16	15	5	20	**13**
30-39	14	18	18	21	9	16	**16**	18	7	11	9	10	5	**9**
40-49	11	3	4	6	5	9	**6**	6	5	0	4	5	7	**4**
50-59	14	9	7	4	12	12	**9**	12	7	5	0	5	2	**5**
60-69	8	6	7	6	2	7	**6**	3	3	7	6	2	2	**4**
70—79	0	5	2	0	7	2	**3**	0	3	0	2	5	5	**3**
80-89	0	0	0	0	0	0	**0**	0	0	2	0	0	0	**0**
90-99	3	2	0	0	0	0	**1**	3	2	0	0	0	0	**1**
100-149	8	5	7	2	12	7	**6**	6	2	0	0	7	5	**3**
150-199	3	5	0	2	0	5	**3**	0	0	0	0	0	0	**0**
200-249	3	0	2	2	0	2	**1**	3	0	2	0	0	0	**1**
250-299	0	2	0	0	5	0	**1**	0	0	0	0	0	0	**0**
300+	0	0	0	0	2	0	**0**	0	0	0	0	2	0	**0**
N	36	65	45	47	43	43	279	34	61	44	47	42	41	269

Table 48. Percent of responses of Lake Sharpe anglers during 2003 who were asked the question: "Do you know that Curlyleaf Pondweed and Eurasian Watermilfoil are found in Lake Sharpe and can be easily transported to other waters?" N is sample size and responses are listed as percentages of total responses.

	Month							
	April	**May**	**June**	**July**	**August**	**Sept.**	**Oct.**	**Total**
N	54	96	79	62	63	58	31	443
Yes (%)	55	74	59	68	81	71	71	69
No (%)	45	26	41	32	9	29	29	31

OAHE MARINA ANGLER USE AND HARVEST SURVEY

History of the Fishery

Historically, the Oahe Marina spring rainbow trout stockings provided youth, elderly and handicapped an opportunity to catch trout close to Pierre. In addition, spring trout stockings provide shore-fishing opportunities when other angling opportunities are limited. Trout caught and released or not caught contribute to a portion of the fish that drive the trophy trout fishery in the Oahe Marina and the Oahe Dam Tailrace throughout the year. A total of 1,018 rainbow trout from 1993 through 1998 were registered for South Dakota proud angler certification (i.e., >2,270 g if kept or 508 mm if released) and 25% (259) were caught in Oahe tailrace and Marina. The average number of proud angler trout recorded from Oahe tailrace, from 1993 through 1998, was 43 per year. This number decreased to an average of 3 per year from 1999 through 2003. During the mid-to-late 1990's the Lake Sharpe trophy trout fishery was maintained, in part, by the inter-basin transfer of trout stocked in Lake Oahe. Inter-basin transfer of fish varies annually and is dependent on the water level of Lake Oahe, the depth of the thermocline in Lake Oahe, and water releases from Oahe Dam (Smith 2000). Contribution of Lake Oahe stocked trout to the Oahe Marina fishery was significant with an estimated 2/3 of the $\geq$ 325 g trout caught in Zone 1 of Lake Sharpe originally being stocked in Lake Oahe (Johnson et al. 1998). The mean weight of trout that were entrained and recovered in Oahe Dam intake tunnels in 1996 and 1997 was 1,584 and 1,522 g and their *Wr*'s all exceeded 100 except for one group near 95 (Johnson et al. 1998). Lake Oahe rainbow trout stockings were discontinued in 2000 due to low prey availability. In 2001 catchable marina trout stockings were increased from 20,000 to 40,000 trout per year, in an attempt to compensate for the loss of trout emigrating from Lake Oahe (Table 49).

Table 49. Rainbow trout brood year, stocking date, number stocked, size and mark (LP=left pectoral fin, RV=right ventral fin, RV/AD=right ventral fin and adipose, CWT=coded-wire tag, LV=left ventral fin, LV/AD=left ventral fin and adipose fin, None=no mark) for Oahe Marina, in Lake Sharpe, from 2000 through 2003.

Brood year	Stocking Date (month/year)	Number Stocked	Size	Mark
1999	4/2000	21,234	7 fish/kg	LP
2000	4/2001	37,744	7 fish/kg	RV,RV/AD,CWT
2001	4/2002	36,493	9 fish/kg	LV, LV/AD, None*
2002	4/2003	35,252	5.5 fish/kg	None*

*No mark. 2002 fish were differentiated from 2003 as fish $\geq$ 330 mm

Results and Discussion

Estimated, trout fishing effort in Oahe Marina from February through May was 4,651 h with an average trip length of 1.79 h (Table 50) which equated to 2,598 angler trips. The average trip length of 1.79 h is similar to the 2.3 h trip length for trout anglers fishing Sheridan Lake (personal communication Greg Simpson). To allow for comparison with previous marina creel surveys, February through April estimates were used. The 2003 estimated fishing effort of 3,326 hours for the February-April period was approximately 3,000 hours lower than 1996 and 1,000 hours lower than 1997 estimates (Riis et al. 1997; Johnson et al. 1998). When the 2003 May creel data was included, fishing effort during this month produced the second highest estimate of fishing effort during the February-May 2003 survey period (Table 50).

Eighty-seven percent of the fishing effort was by bait and spin casting anglers and the majority of this effort occurred during April and May, after the stocking of catchable trout. Fishing effort varies annually due to erratic winter and spring weather conditions, in part, that determine fishing effort in the Oahe Marina.

Total catch rates (fish/h) ranged from a low of 0.31 in March for fly anglers to a high of 5.22 in April for bait/spinning anglers (Table 52). The high catch rates in April and May for both bait/spin casting and fly anglers was a result of the April stockings of catchable trout (Table 50). Harvest rates (fish/h) of carryover trout ranged from a high of 0.62 in March for ice anglers (March 1st through 15th) to a low of 0.0 for fly anglers in April. Typically ice anglers are harvest orientated and fly anglers are catch and release orientated (Table 52). An ice or bait/spinning angler would have to fish 1.9 hours to catch one carryover trout from February through March and 7.3 hours from April through May of 2003.

Total harvest of carryover rainbow trout was estimated at 1,047 fish during the February-May 2003 period (Table 53). To allow for comparison with previous marina creel surveys, February through April harvest estimates were used. The harvest of carryover rainbow trout (i.e., 330 mm) in 2003 was 840 compared to 293 in 1996 and 258 in 1997. The number of carryover trout harvested in 2003 was 2.9 to 3.2 times greater than those captured in 1997 and 1996. A total of 76 trout $\geq$330 mm in the angler harvest were measured during the February to May 2003 creel. Of trout measured during the February-May 2003 creel survey, 88% (n=67) were age-2 fish, 7% (n=5) were age-3 fish and the age of 5% (n=4) of the trout measured was unknown. Previous studies documented that growth of Lake Oahe and the Oahe tailrace rainbow trout is rapid and mortality rates, especially of age 4 and 5 fish, are high (Riis et al. 1996). Mean length of harvested trout during the 2003 survey was 386 mm and mean weight was 563 g. The mean length of carryover trout measured during the 1997 survey was 411 mm and the mean weight was 943 g. For both 1997 and 2003, the mean length of fish measured was similar but the 1997 trout mean weight was 380 grams heavier. The 2003 stock density indices for carryover rainbow trout caught in the Oahe Marina were PSD=22, RSD-P=4, RSD-M=0 and RSD-T=0. Trout *Wr* for all size groups of trout in 2003 decreased with increasing fish length (R^2=0.08; P$\leq$0.05) while *Wr* values for trout in 1996 and 1997 remained high across all size groups (Table 51). Lynott et. al (1995) found that rainbow smelt dominated diets of Lake Oahe rainbow trout >460 mm and Scott and Crossman (1973) stated a diet of primarily prey fish is necessary for rainbow trout to achieve a large size. Cumulative rainbow smelt entrainment through Oahe Dam dropped considerably from 1997 to 1999, decreasing from 444 million in 1997, to 4 million in 1998, and 2 million in 1999 (Smith 2000). With the extreme low abundance of Lake Oahe prey fish, especially rainbow smelt, in the late 1990's and early 2000's, it is likely entrainment (i.e., tailrace prey fish availability) was low which limited size and growth of carryover trout.

An estimated 17,458 rainbow trout were caught from February through May 2003, of which 1,135 were carryover fish. Approximately 46% (16,323) of the newly stocked catchable trout were caught and 9% (3,252) of the catchable trout stocked were harvested during April and May 2003.

Anglers were asked one preference question; "How would you rate your trip". The median trip rating for fly and shore/wading fishing was "good" (median of 3) and slightly lower for ice fishing with a median rating of "fair" (median of 2, Table 54). Overall, 70% of anglers rated their trip "good" or "excellent". Twenty-six percent rated their trip "fair" and 4% of the

respondents rated their trip as “poor”. A 70% good or excellent rating is acceptable for this fishery.

Table 50. Trout fishing effort (angler-h), by fishing type, in Oahe Marina, Lake Sharpe, February through May 2003. Standard errors are in parentheses.

Month	Fishing Group			
	Ice Fishing	Bait/spin	Flyfishing	Total
Feb.	86.9 (59.8)	10.4 (20.5)	---	97.3 (80.3)
March	363.6 (338.4)	164.8 (323.6)	79.2 (98.2)	607.6 (760.2)
April	---	2,566.8 (1,195.4)	53.9 (70.8)	2,620.7 (1,266.3)
May	---	1,325.6 (604.7)	0	1,325.6 (604.7)
Total	450.8 (398.2)	4,067.6 (2,144.2)	133.1 (169)	4,651.2 (2,711.5)

Average trip length 1.79 hr = 2,598.4 angler trips

Table 51. Mean relative weight (*Wr*) by length class for angler caught rainbow trout. Number of fish per size group is in parenthesis.

Length Category	Size Range (mm)	1996 *Wr*	1997 *Wr*	2003 *Wr*
Stock – Quality	≥250 to <400	116.6 (8)	106.2 (39)	94.2 (54)
Quality – Preferred	≥400 to <500	124.8 (34)	110.9 (34)	92.0 (11)
Preferred – Memorable	≥500 to <650	128.7 (5)	103.4 (10)	76.8 (1)
Memorable – Trophy	≥650 to <800	----	98.4 (1)	----

Seventy percent of the anglers fishing for trout in Oahe Marina were from Hughes and Stanley Counties. The remaining 30% of anglers was comprised of South Dakota residents from 34 counties and non-residents from eight states (Table 55).

Table 52. Catch-per-unit-effort (fish/angler-h), by angling type, for total catch, harvest of trout ≥ 330 mm (carryover), harvest of 2003 stocked catchable trout, and release rate for 2003 stocked catchables and carryover trout (+/- 95% confidence interval).

Month	Ice Fishing				Bait/Spinning				Fly Fishing			
	Total Catch	Harvest ≥330 mm	Harvest Catch-Able	Total Release	Total Catch	Harvest ≥330 mm	Harvest Catch-able	Release	Total Catch	Harvest ≥330mm	Harvest Catch-able	Release
Feb	.53 (.83)	.53 (.83)	---	0	0	0	0	0	---	---	---	---
March	.62	.62	---	0	.48 (.73)	.46 (.74)	---	.02 (.04)	.31 (.55)	.10 (.29)	---	.20 (.51)
April	---	---	---	---	5.22 (5.42)	.13 (.15)	.87 (.60)	4.22 (4.67)	1.33	0	0	1.33
May	---	---	---	---	2.59 (3.91)	.16 (.28)	.77 (.69)	1.66 (2.94)	---	---	---	---

All anglers interviewed - trout

Table 53. Total catch and harvest of rainbow trout ≥ 330 mm (carryover), harvest of 2003 stocked catchable trout and release for 2003 stocked catchables and carryover trout (+/- 95% confidence interval).

Month	Ice fishing				Bait/spinning				Fly Fishing			
	Total Catch	Harvest ≥330 mm	Harvest Catch-able	Total Release	Total Catch	Harvest ≥330 mm	Harvest Catch-able	Total Release	Total catch	Harvest ≥330 mm	Harvest Catch-able	Total Release
Feb	46.7 (60.1)	46.7 (60.1)	---	0	0	0	0	0	---	---	---	---
March	225.5 (250.3)	225.5 (250.3)	---	0	235.3 (363.1)	225 (362.5)	---	10.3 (24.5)	24.2 (31.6)	8.1 (20.3)	---	16.1 (34.3)
April	---	---	---	---	13,419.7 (8641.5)	334.7 (213.3)	2,222.4	10,861.0 (7,716.7)	71.8	0	0	71.8
May	---	---	---	---	3,434.9 (3,309)	207.5 (277.9)	1030	2,196.5 (2,589.9)	0	0	0	0
Total	272.2 (310.4)	272.2 (310.4)	---	---	17,089.9 (12,313.6)	767.2 (853.7)	3,252.4	13,067.8 (10,331.1)	96 (31.6)	8.1 (20.3)	0	87.9 (34.3)

Total number of parties interviewed (n=204)

Table 54. Response to the question, “How would you rate your trip today?” 1 = poor, 2 = fair, 3 = good, and 4 = excellent, by type of fishing. N is sample size, February through May 2003.

	How would you rate your trip today?					
Fishing group	**1**	**2**	**3**	**4**	**N**	**Median**
Ice Fishing	2	10	7	2	21	2
Fly Fishing	1	2	4	3	10	3
Shore/Wading	6	40	75	52	173	3
Total	**9**	**52**	**86**	**57**	**204**	
Percent	**4**	**26**	**42**	**28**		

Table 55. County of residence for anglers fishing Oahe Marina, Lake Sharpe, South Dakota from February through May 2003.

County	N	Percent
Hughes	124	61.4
Stanley	17	8.4
Other*	61	30.2
Total	**202**	**100**

*Other includes anglers from 34 South Dakota counties and 8 locations outside the state.

Management Implications

Harvest of carryover rainbow trout in 2003 was approximately 3 times greater than the number harvested in 1996 and 1997. However, the average weight of the 2003 carryover trout was 380 g less than in 1997. Higher mean lengths and weights of carryover trout captured in 1996 and 1997 in Oahe Marina was due to the large average size and excellent condition of trout originating in Lake Oahe, along with these fish entering a tailrace environment with abundant food.

If the timing of increased stockings coincides with abundant prey fish in the tailrace (i.e., entrained rainbow smelt) trout size structure, growth rates, and average size will increase. From 2001 through 2003 stocking rates were increased but they coincided with low abundance of prey fish in Lake Oahe, which equates to low food availability in the tailrace. Due to the limited hatchery space and the high cost of rearing catchable trout, the best cost/benefit ratio will likely be realized by decreasing the total number of catchable trout stocked. By stocking a minimum of 24,000 catchable trout each spring in the Pierre area, management objectives will likely be met and food availability will determine condition, growth rates, and size of carryover trout caught by anglers. It is unknown if large numbers of trophy size (1,814-6,350 g) trout will be produced. However, it is unlikely trout numbers and sizes captured in 1996 and 1997 can be replicated without the contribution of entrained large trout from Lake Oahe.

The Oahe Marina and tailrace catchable and trophy trout fishery is important to a diverse group of anglers. However, the cost and hatchery space limitations of various stocking rates needs to be weighed against the benefits of angler use and satisfaction. Requesting a smaller number of catchable rainbow trout, increasing the frequency of stocking and exploring

other stocking locations in the Pierre area should more equitably distribute the catch of trout and still maintain a ≥70% angler satisfaction rating. Reducing the number of catchable trout stocked will negatively effect the number of trophy trout in the future. However, the size of trout in the Pierre area is likely more dependent on food availability and water releases, than the number of catchable rainbow trout stocked.

Throughout this discussion the assumption is made that the majority of the catchable trout stay within the coldwater tailrace habitat (i.e., Oahe Dam tailrace to the mouth of the Bad River). The short term (April through May) dispersal of newly stocked rainbow trout is understood and is dependent on water releases from the dam. Below average water releases in April and May equate to more trout remaining in the Oahe Marina/tailrace area versus average water releases eventually moving trout further down river into the stilling basin and along the rip rap in the Pierre area (Johnson et al. 2002). However, after the May time period, the location, movement and habitat use of carryover and catchable trout is unknown. A telemetry project would answer these questions and provide information for anglers to use when targeting trout in Lake Sharpe.

Recommendations

1. Reduce annual stocking request each spring and stock fewer fish more frequently during the April and May “put-and-take” fishery.
2. Explore stocking catchable rainbow trout in the Pierre area, in addition to Oahe Marina, to increase angler use and return rates.
3. Conduct a marina creel every 3 to 5 years to evaluate the catchable and carryover trout harvest in the Pierre area. Creel surveys should include angler preference and satisfaction questions relating to the number and size of trout caught and angler demographics (i.e., age).
4. Increase the distinction of newly stocked catchable from carryover trout by increasing carryover minimum cutoff fish length to ≥330 mm, improve education of creel clerks in recognizing regenerated and partial fin clipped fish, mark all fish stocked and measure 50 trout from each hatchery to determine the size range of stocked fish.
5. Determine a way to get a better estimate of the number and size of carryover trout caught and released by fly anglers.
6. Annual Lake Sharpe bus route creels should be used to monitor (i.e., April and May) angler trout harvest and use in years when Oahe Marina creels are not scheduled.
7. Stocking requests should include a statement that statewide surplus catchable rainbow trout be stocked in the Oahe tailwaters.
8. Determine rainbow trout food habits, mortality, age, and growth rates to determine if food type and availability limits trout size during periods of low prey fish availability.
9. Complete a rainbow trout telemetry study to determine habitat utilization and movement of rainbow trout in Lake Sharpe.

WALLEYE FISHERY STATUS AND 2003 OUTLOOK

Walleye abundance in 2003, as indexed by gill net CPUE (Table 3), was similar to other years in the 1999-2003 period, though at the low end of the range of values estimated. The 2000 walleye year class comprised the largest proportion of the gill net catch (33%), followed by the 2001 (23%) and 1999 (19%) year classes, based on age interpretation from otoliths (Table 5). The majority of the fish in the Lake Sharpe walleye population in August 2003 were from the 2000 and 2001 year classes and between 340 and 380-mm in length (Figure 3). While CPUE of walleye <381-mm in length was unchanged from 2002 to 2003, CPUE of walleye 381-457-mm and >457-mm in length decreased from 2002 to 2003 (Figure 4). Recruitment of the 2002 year class into the walleye population in 2003 was low (Tables 5, 13, and 14), and early indicators of recruitment of the 2003 year class to the population indicate an average year class, similar to those produced in 1996, 1999, and 2001. However, a low abundance of age-0 gizzard shad in the fall of 2003 may result in high overwinter mortality of age-0 walleye due to cannibalism. When the current walleye population age structure and abundance indices are examined, walleye CPUE in the standard gill net survey in 2004 is expected to decrease from the 2003 value.

Walleye condition in 2003, as indexed with *Wr* values, was the lowest of the 1997-2003 period, and signifies slow growth during the 2002-2003 growing season (Table 10). Slow growth may be due to low age-0 gizzard shad abundance, as indexed by the fourth lowest age-0 gizzard shad seining CPUE since the survey was initiated in 1982. Slow growth of walleye during the 2002-2003 period, and low recruitment of the 2002 year class, will mean a reduction in the rate of replacement of walleyes >381-mm harvested during 2003 and 2004 and a reduction in population size structure and abundance.

Low age-0 shad abundance and the high proportion of the walleye population between 340 and 380-mm in length, were likely contributing factors to the high catch rates of walleye by anglers documented during the April-July period of 2003 (Table 31). Hourly catch rates of walleye 340-380 mm in length are generally higher than for larger fish.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Walleye regulations currently in effect have been successful at reducing harvest enough to maintain the quality of the Lake Sharpe walleye fishery. The 15-inch minimum length limit, in effect during all months except July and August, has increased the average length of walleye in the angler harvest and added stability to the walleye population by keeping walleye in the population longer. However, during periods of high fishing pressure, high hourly catch rates of walleye by anglers, and a high percentage of walleye caught being released to obey length limits (such as June 2003), hooking mortality of released fish may be substantial. During June 2003, an estimated 192,143 walleye were caught on Lake Sharpe, of which 11,103 were harvested and 181,040 were released (Tables 26 and 27).

If a conservative mortality rate estimate of 10% for walleye caught and released (hooking mortality) is applied to the June release estimate, an additional 18,104 walleye were killed but not harvested during June, a value higher than the estimated harvest for that month. However, if the minimum length limit was not in place during June 2003 and harvest per trip was similar to July 2003 at 2.2 walleye/trip (conservative estimate), walleye

harvest in June 2003 would have been approximately 54,500 walleyes. Under this scenario, the annual sustainable harvest goal of 100,000 walleyes would have almost been reached by the end of June. It is likely that actual harvest during June would have been much higher than 54,500 walleyes because fishing pressure would have increased as a result of a high percentage of anglers achieving a daily limit.

Even without a minimum length limit in place during July and August of 2003, anglers still only kept 31-43% of the walleye caught (Table 34). The one walleye ≥ 457-mm in length restriction had little effect at reducing harvest of walleye ≥ 457 mm in 2003 and will likely have even less impact in 2004 because the abundance of walleyes >457-mm in length and the proportion of the population they comprise decreased from 2002 to 2003. Even though the one walleye ≥ 457-mm in length restriction may have little effect on reducing harvest of walleye, the regulation still helps instill in anglers the value of large walleyes. It is hoped that anglers will eventually begin changing their harvest patterns and begin voluntarily releasing walleye longer than 457-mm in length. Walleyes from the 1994 and 1995 year classes comprised the majority of the walleyes sampled >457-mm in length in 2003.

Smallmouth bass were introduced into various sections of Lake Sharpe from 1980-1991. The new 305-457-mm (12-18-inch) protected slot length limit, implemented in 2003, will protect the majority of the fish longer than 305 mm from harvest, while allowing harvest of younger year classes until they reach approximately age 4. The goal of the new smallmouth bass regulations is to increase the abundance of smallmouth bass longer than 18 inches in length to develop a quality catch-and-release smallmouth bass fishery. Protecting smallmouth bass between 305 and 457-mm in length, while allowing harvest of bass less than 305-mm in length should help restructure the pounds of smallmouth bass per acre to accomplish this goal. However, it will take a number of years to document any changes in the smallmouth bass population resulting from the new regulations. High catch rates of smallmouth bass by anglers during 2003 are likely associated to low prey availability, not an increase in abundance of bass from 2002 to 2003. Spring electrofishing CPUE of smallmouth bass was unchanged from 2002 to 2003 but bass condition decreased during this time period, likely in relation to low prey availability.

RECOMMENDATIONS

1. Continue and improve fish population and angler use, harvest and preference surveys on an annual basis. Specifically, increase efforts to gather quality data on the smallmouth bass fishery to evaluate regulations placed in effect for 2003, continue to work at developing adequate indices of walleye year class strength at age-0 and age-1, and increase understanding of factors affecting the annual production of gizzard shad in Lake Sharpe.

2. Work closely with the United States Army Corps of Engineers and state and local governments to address issues concerning the degradation of fish habitat in the middle zone of Lake Sharpe associated with the Bad River confluence.

3. Continually evaluate current walleye and smallmouth bass regulations to determine regulation appropriateness and effectiveness at maintaining the quality of the Lake Sharpe walleye fishery.

4. Establish better working relationships with local governments and economic interests on aquatic nuisance species issues and fishing regulations, and convey the limited harvest potential of fisheries resources to these groups.

5. Age walleye captured during the standard gill net survey from otoliths only, to improve estimates of growth rates and population age structure and reduce processing time related to walleye age and growth determination.

6. Promote under-utilized species such as channel catfish and white bass to increase angler harvest opportunities without increasing walleye harvest.

7. Conduct an in-depth study of gizzard shad population dynamics, as they relate to the predator-prey system in Lake Sharpe. Specifically, determine how annual fluctuations in age-0 gizzard shad abundance influence walleye and smallmouth bass catchability and seasonal growth patterns.

8. Increase efforts to educate the public concerning aquatic nuisance species found in Lake Sharpe and how to prevent their spread to other waters.

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APPENDICES

Appendix 1. Common and scientific names of fishes mentioned in this report.

Common Name	Abbreviations	Scientific Name
Bigmouth buffalo	BIB	*Ictiobus cyprinellus*
Black bullhead	BLB	*Ameiurus melas*
Black crappie	BLC	*Pomoxis nigromaculatus*
Blue catfish	BCF	*Ictalurus furcatus*
Bluegill	BLG	*Lepomis macrochirus*
Blue sucker	BSR	*Cycleptus elongatus*
Bluntnose minnow	BLM	*Pimephales notatus*
Channel catfish	CCF	*Ictalurus punctatus*
Chinook salmon	FCS	*Oncorhynchus tshawytscha*
Common carp	COC	*Cyprinus carpio*
Emerald shiner	EMS	*Notropis atherinoides*
Fathead minnow	FHM	*Pimephales promelas*
Freshwater drum	FRD	*Aplodinotus grunniens*
Gizzard shad	GZD	*Dorosoma cepedianum*
Goldeye	GOE	*Hiodon alosoides*
Johnny darter	JOD	*Etheostoma nigrum*
Lake herring	LAH	*Coregonus artedii*
Largemouth bass	LMB	*Micropterus salmoides*
Northern pike	NOP	*Esox Lucius*
Rainbow smelt	RBS	*Osmerus mordax*
Rainbow trout	RBT	*Oncorhynchus mykiss*
Red shiner	RES	*Cyprinella lutrensis*
River carpsucker	RIC	*Carpiodes carpio*
Sand shiner	SAS	*Notropis stramineus*
Sauger	SAR	*Sander canadensis*
Shorthead redhorse	SHR	*Moxostoma macrolepidotum*
Shortnose gar	SHG	*Lepisosteus platostomus*
Shovelnose sturgeon	SHS	*Scaphirynchus platorynchus*
Smallmouth bass	SMB	*Micropterus dolomieu*
Smallmouth buffalo	SAB	*Ictiobus bubalus*
Spottail shiner	SPS	*Notropis hudsonius*
Walleye	WAE	*Sander vitreus*
White bass	WHB	*Morone chrysops*
White crappie	WHC	*Pomoxis annularis*
White sucker	WHS	*Catostomus commersoni*
Yellow perch	YEP	*Perca flavescens*

Appendix 2. Standard weight equations used for relative weight (*Wr*) calculations. Length is in millimeters, weight is in grams, and logarithms are to the base 10.

Walleye	$\text{Log}W_s$=3.180LogTL-5.453
Sauger	$\text{Log}W_s$=3.157LogTL-5.446
Channel catfish	$\text{Log}W_s$=3.294LogTL-5.194
Yellow perch	$\text{Log}W_s$=3.114LogTL-5.138
White bass	$\text{Log}W_s$=3.230LogTL-5.386

Appendix 3. White bass, and yellow perch proportional stock density (PSD), relative stock density (RSD-P and RSD-M), and relative weight (*Wr*) for 1997-2003, from Lake Sharpe. Mean *Wr* values for 2002 and 2003 are for stock-length fish only.

White bass

Year	PSD	RSD-P	RSD-M	Wr	N
1997	96	58	13	94	24
1998	94	94	22	101	18
1999	100	72	24	102	54
2000	98	83	13	99	55
2001	100	91	26	100	46
2002	68	15	8	100	71
2003	96	39	13	91	70

Yellow perch

Year	PSD	RSD-P	RSD-M	Wr	N
1997	43	4	0	89	23
1998	28	6	0	91	18
1999	59	27	0	82	22
2000	22	6	0	85	36
2001	55	0	0	86	20
2002	42	8	0	77	24
2003	25	8	0	85	23

Appendix 4. Angler satisfaction, preference, and attitude questions asked in conjunction with the 2003 Lake Sharpe angler use and harvest survey.

How would you rate your fishing today in terms of catching the sizes of fish you were expecting?

How would you rate your fishing today in terms of catching the numbers of fish you were expecting?

Considering all factors, how satisfied are you with your fishing trip today?

In your opinion, what would be a reasonable total number of walleyes for one person to keep and eat or give away in a year?

About how many walleyes do you keep and eat or give away in a single year?

On average, about how many days do you fish in South Dakota in a year?" and to the question

How many of those days are on Lake Sharpe?

Do you know that Curlyleaf Pondweed and Eurasian Watermilfoil are found in Lake Sharpe and can be easily transported to other waters?